Santa Clara Valley Water District

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PILOT WATER SOFTENER REBATE PROGRAM

Prepared for
California Department of Water Resources
by Santa Clara Valley Water District
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FINAL REPORT
MAY 2006

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By

Santa Clara Valley Water District

May 2006

Project Team:

Hossein Ashktorab, Water Use Efficiency Unit Manager

Ray Wong, Associate Engineer, Project Manager

Shicha Chander, Assistant Engineer, Project Manager

Junlin Linda Liu, Project Administrator, Student Intern

Toni Vye, Senior Office Specialist

Kurt Elvert, Field Inspector, Student Intern

Borhan Oskoorouchi, Field Inspector, Student Intern

Milad Emandi, Field Inspector, Student Intern

Amanda Cox, Field Inspector, Student Intern

Marcel Sicotte, Field Inspector, Student Intern

Water Use Efficiency Unit Staff:

Jerry De La Piedra, Pam John, Shing Kong, Jeannine Larabee, and Robert Siegfried

Consulting Team:

Sanjay Gaur and Jerome Sayre

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California Water Service Company
City of Gilroy
City of Santa Clara
City of Sunnyvale
City of Morgan Hill
Great Oaks Water Company
San Jose Municipal Water System
San Jose Water Company
San Jose/Santa Clara Water Pollution Control Plant

We are most grateful for the voluntary efforts from local water softener retailers, manufacturers, and retail stores who continuously informed their customers about the Pilot Water Softener Rebate Program:

Ecowater Systems
Randazzo's Water Conditioning
Culligan
Rayne Water
General Electric Water
Crystal Choice
Sears
Home Depot

We would also like to extend our gratitude to the Water Quality Association for providing technical advice on water softening devices, and to others we have no doubt forgotten. Thank you all.

EXECUTIVE SUMMARY

This report presents an evaluation of the Pilot Water Softener Rebate Program (Program) implemented by the Santa Clara Valley Water District (SCVWD) from 2003-2004. Funded in part by a grant from the California Department of Water Resources (DWR), this Program was designed to test the effectiveness of using financial rebates to customers in Santa Clara County (County) to promote the replacement of old timer-based water softeners with more efficient models such as Demand Initiated Regeneration (DIR) or no-salt water filters. A Program such as this one would result in water savings and would be an important water conservation measure.

Results

The Program resulted in water, salt and wastewater treatment cost savings. The estimated savings and customer monetary savings of the Program are summarized below.

Water Savings - The methods used for water savings estimations are based on either (1) the participant's monthly water bills; or (2) the average water use for regeneration data of the five most popular water softener models purchased by participants, based on calculations from water softener manufacturers. The total annual water savings resulting from the Program are 1,321,910 gallons (1,770 CCF[1]) from Methods 1, or 1,202,100 gallons (1,930 CCF) from Method 2.

Salt Reductions - The estimated salt reduction from water softeners was calculated based on 206 customer responses from the 395 survey forms sent to the Program participants. The average annual salt reduction as a result of the Program was 240,000 lbs of salt that would otherwise have been discharged to the wastewater system.

Wastewater Treatment Plant Operation Cost Savings - The average savings in the wastewater treatment operating cost is estimated at $1,623 per year based on the water savings of 1,321,910 gallons per year (or 4.1 acre-foot/year) from Method 1, and the estimated treatment cost of $400 per acre-foot (AF)[2].

Customer's Monetary Savings - The customers' monetary savings from the Program include savings on their water bill and salt purchases. With the water savings estimated, the annual savings per participant on water use and salt purchases is $8.80 and $75, respectively.

Benefit Cost Analyses - Based on the information in the rebate application submitted by participants, the total cost of the 400 water softeners was $288,218. The benefit-cost ratio for participants, calculated based on the customers' monetary savings on water less salt purchases, is 2.08. The ratio showed that the Program is cost effective for the overall community. On the other hand, the benefit-cost ratio for the SCVWD is 0.45. This is based on the savings on the purchase cost of $430 per acre-foot for new water resulting from the water savings of this Program. However, the benefit-cost ratio for the SCVWD does not include the non-quantifiable monetary benefits listed below:

- Reduction of demand for water imported from the Bay-Delta to urban water agencies.
- Reduction of total dissolved solids, detergents, and other cleaning compounds discharged to sewer systems.
- Reduction of total dissolved solids, sodium, and chloride concentrations in the recycled water.

[1] 1 CCF = 100 cubic feet = 748 gallons

[2] 1 acre-foot = 43,560 cubic feet = 325,861 gallons

The benefit-cost ratio also indicates the importance of financial assistance from others, such as DWR, to the implementing agency.

A follow-up customer survey was sent to evaluate the effectiveness of marketing channels, customer satisfaction, and Program salt savings. The survey received a 52% response rate. Results indicated 93% of respondents used less bags of salt after switching to more efficient water softeners.

Based on what worked well and "lessons learned," recommendations for a future full-scale program are summarized as follows:

The Program demonstrated that the rebate amount tested ($150 per participant) provides sufficient financial incentive to customers to replace their timer-based water softeners with more efficient water softeners of either salt regeneration or no-salt regeneration types.

Research and Design Phase

- Research and obtain the most common DIR product and no-salt regeneration filter type used and their cost.
- Determine the rebate amount to attract the largest number of participants.

Marketing Phase

- Work closely with water retail agencies and water softener retailers to promote the rebate program by providing rebate information to water softener retail stores and by inserting rebate information in the monthly water bill statements.

Operational Phase

- Provide information on the water hardness data to customers as part of the pre-inspection process so that hardness settings on new DIR water softeners can be set correctly to achieve further reductions in salt usage.
- Reduce the number of disqualifications by re-emphasizing the purchase of a DIR model water softener or no-salt water conditioners/filters as the rebate's requirement.
- Conduct random Program final inspections of about 10% of the number of rebates issued.

Data Analysis

- Continue to collect participant consumption data to monitor water savings over five years.

Public Education

- Provide public information regarding basic water softeners operations, potassium chloride, water hardness setting, and seasonal water quality variation.

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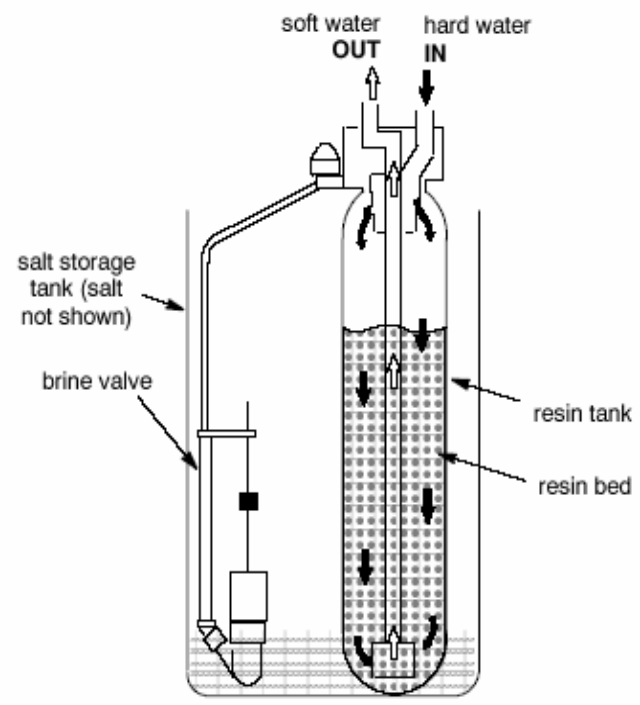
1. INTRODUCTION

The Santa Clara Valley Water District is a water management agency, wholesaling water to 13 retail water companies and agencies and providing flood protection and watershed management for 1.7 million residents in the County. The SCVWD's mission is to ensure a reliable water supply that will meet both current and future needs of our community, including stewardship of the environment. The SCVWD helps meet the community's water needs in part by promoting water conservation and water recycling through a wide variety of programs. The SCVWD relies on local aquifers for almost half of its water supply, importing the remainder from the Sierra Nevada and the Sacramento-San Joaquin Bay Delta through the Central Valley Project and State Water Project systems.

While local groundwater is of high quality, it is also naturally rich in minerals, including calcium and magnesium, which produce high levels of water hardness. Hard water decreases the effectiveness of soaps and detergents, shortens the useful life of laundered fabrics, and leaves a characteristic residue on skin and hair. It also contributes to scaling of hot water heaters, pipes, and other appliances. Consequently, residential customers in the County have commonly installed water softeners in their homes.

A water softener reduces the calcium or magnesium ion concentration in hard water through an ion exchange process (a chemical adsorption process). Hard water is passed through a column of the sodium form of a cation exchange resin, which replaces the calcium and magnesium ions from the hard water with sodium ions. When the exchange capacity of the resin for adsorbing calcium and magnesium ions is exhausted, the column is regenerated with either a sodium chloride or potassium chloride solution. The amount of salt used for regeneration various from 4 lbs to 5 lbs per cubic foot of resin depending on the water softener's model and brand. Thus water softeners are important contributors of salt to the wastewater streams and in turn contribute to higher salinity in recycled water.

Figure 1. Water Softener Regeneration



The Program was implemented by the SCVWD in November 2003 to September 2004. Funded in part by a grant from the California DWR, this Program was designed to test the effectiveness of using financial rebates to water consumers to promote the replacement of old water softeners with newer models that discharge less salt or no salt into sewer systems. These new models use Demand Initiated Regeneration (DIR) (see Figures 2 and 3), implementing ion exchange only when a hardness limit is exceeded, and thereby limiting discharge of salt-laden water. DIR water softeners determine when the resin must be recharged, either electronically or with a meter that measures and calculates usage. This type of softener not only saves water and energy, but also reduces the amount of salt that would otherwise be discharged to the sewer system.

The efficiency of a water softener is defined as the hardness (grains) removed from the source water divided by the salt used (pounds) in a regeneration cycle. Timer-based water softeners (Figures 4 and 5) have been found to be very inefficient, using tremendous amounts of water and salt because they are regenerated at preset intervals whether or not regeneration is necessary. In general, the greater the amount of salt discharged into the wastewater stream, the greater the risk of adverse impacts. These include adverse impacts on the environment, on agricultural and landscape irrigation, and on the use of reclaimed water. In addition, water softeners increase overall water demand, putting pressure on limited water supplies.

Figure 2. and Figure 3. Demand Initiated Regeneration water softeners

Figure 4. and Figure 5. Timer-based water softeners

1.1 *Program Evaluations*

This report describes the Program from the initial design phase to the marketing phase and the operational phase. The report ends with an evaluation on water, energy, and salt savings from the Program, and briefly describes the expected ancillary benefits to the environment and the collaborative California State and Federal water management system for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta). Each section discusses what did and did not work, and suggests steps for improving the Program in the future.

1.2 *Research and Design Phase*

1.2.1 Description

In the research and design phase, SCVWD staff conducted a number of interviews and reviewed existing literature and marketing materials. Research focused on:

- **Water softener legislation** – Review of legislation on water softeners enacted by the State of California including Senate Bill (SB) 1006, enacted in November 1999, that established salt efficiency standards for all water softeners sold in California. These standards cannot be met with timed regeneration softeners, and all water softeners sold in the State now use DIR technology.

- **Water softener technology** – Interviews with national and local water softener vendors and manufacturers including Sears, Crystal Choice (a program of the San Jose Water Company), Culligan, Rayne Water, Ecowater, Randazzo's Water Conditioning, and the Water Quality Association industry group. Ecowater is an original equipment manufacturer (OEM), manufacturing water softeners for sale under brands carried by major home supply retailers. The potential for joint marketing of the rebate program was discussed at this time. Staff also visited several home supply retailers to review available models and price range. The most widely available models were priced between $350 and $800.

- **Rebate forms** – Staff reviewed rebate forms used in other water conservation programs within the SCVWD.

- **Past consumer data**– Staff reviewed data on participants from two SCVWD programs that captured data on water softener ownership: the ongoing Water-Wise House Calls program (a water use survey program) and the 2002-2003 Residential Water Use Baseline Survey (a randomized selection of residential water users). However, the data reviewed did not indicate the type of water softener technology used.

- **Rebate amount** - The SCVWD based its decision on the rebate amount on two factors:
  1) The range of retail prices of water softeners surveyed in the research phase, and
  2) The desire for a large sample of participants for evaluation purposes.

While a $300 rebate was originally considered, this was found to be almost 100% of the cost of lower-end water softener models. This amount allowed for only 200 rebates to be offered from the $60,000 DWR grant amount. SCVWD staff felt this would provide a limited sample size for evaluating the pilot program and chose instead to offer rebates of $150, almost half the cost of lower end softeners but allowing a larger number of consumers, 400, to participate.

Based on this initial research, SCVWD staff designed the rebate program and prepared a rebate form and accompanying letter to be sent to 1,200 households identified as users of water softeners. Table 1 summarizes the tasks and costs for this phase.

Table 1. Research and Design Phase Tasks

Task	*Cost*
Review Legislation	$304
Research Water Softeners	$3,474
Review Water User Database	$140
Review/Design Rebate Forms	$2,030
Legal/Administrative Services	$1,930
Total Research & Design Phase	***$5,948***

Source: SCVWD water softener rebate program records

1.2.2 Evaluations

Survey reports on rebate program design in the water industry show designs vary considerably based on the objective of each program. Maximizing water consumer participation is a common objective in all such programs and success here depends largely on two factors:

1) Identifying the ***rebate amount*** that will attract the largest number of participants within the funding available, and
2) Determining which ***marketing channels*** will reach those participants.

Marketing channels are discussed later in this report. To identify the optimum rebate amount a few rules of thumb exist:

- *The maximum rebate amount should be the difference between the standard product and the water saving product.* For example, if the cost for the standard product is $50, and the cost for the water saving product is $125, the maximum rebate amount should be $75. However, in the case of water softeners, there are no "standard" products recommended by the SB 1006 legislation noted earlier. There is a wide range in prices for new DIR products, from hundreds to thousands of dollars.

- *Increased public perception of the need for water conservation may decrease the monetary incentive needed to attract participants.* Public education by the State about the environmental impacts of salinity in particular may stimulate increased participation in water softener rebate programs regardless of the amount of rebate being offered. Experience with ultra-low flow toilet rebate programs has shown that lower rebate amounts have been effective in times of water rationing or during increased public education campaigns.

- *Non-economic factors influence participation more than monetary incentives.* Several studies on rebate programs for energy conservation show that for residential customers, participation is influenced less by the incentive amount than by how the Program is marketed, convenience of the application process, and time and effort required to implement the change – all non-economic factors.

As noted above, the marketing and operations phases of a rebate program can impact participation rates more than the amount of the rebate.

1.3 *Marketing Phase*

1.3.1 Description

The marketing of the water softener rebate evolved over the course of the Program. Initially, the SCVWD planned a limited effort to promote the Program among a relatively small group of water users via direct mail. With limited rebates, the SCVWD was concerned that it might be overwhelmed by a high response rate. After response rates proved to be less than desired, additional measures were considered. The marketing phase of the Program offers several lessons for larger future programs in achieving greater program participation. The major elements in marketing the Program are outlined below.

1.3.2 Initial Outreach

- **Required Public Meeting Held** – On June 12, 2003, SCVWD staff held a public meeting soliciting comment on the upcoming rebate program. The meeting had been announced in a one-day notice in the regional daily newspaper, the San Jose Mercury News. Attending the meeting were five representatives from water softener retailers or manufacturers. SCVWD staff modified the original presentation to incorporate a round-table discussion to seek greater input from the small number of participants (Appendix A).

- **Direct Mailing to 1,200 Water Softener Users** - In November of 2003, the SCVWD launched the Program with a mailing to the 1,200 customers identified as owning water softeners in the research and design phase. The mailing consisted of a letter and an application form for the rebate. Appendices B and C of this report contain the letter and rebate application form.

- **Email Notification to Water Retailers** – Also in November 2003, the SCVWD sent an email about the Program to all its water retailers. The email explained the purpose of the Program and included the letter and water rebate form used in its direct mailing.

- **Specialty Retailers Promote Program** – Of the five water softener retailers who were either interviewed or received notice of the June public meeting, two voluntarily chose to promote the Program to their customers by distributing flyers while out on service calls.

- **Home Supply Retailers Promote Program** – Several local home supply retail stores also voluntarily chose to promote the Program, with retail staff verbally informing customers interested in water softeners that a rebate was available, and/or posting the rebate form in their stores.

1.3.3 Additional Outreach

Between November 2003 and March 2004, the SCVWD approved and processed rebate applications for less than 60 water softener users. Faced with this limited response three months after the Program launched, the SCVWD took further action.

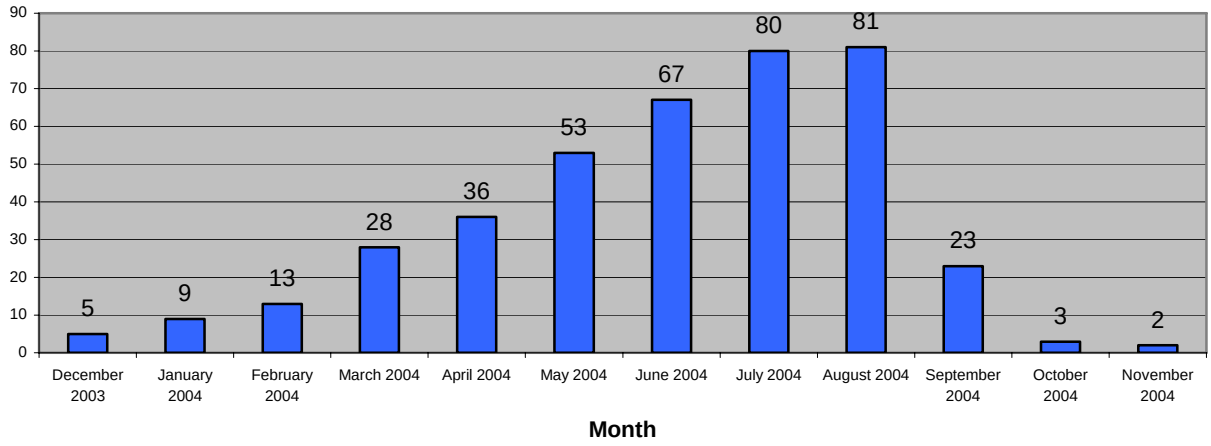
In early March 2004, SCVWD representatives met with the San Jose Water Company, the SCVWD's largest water retailer serving one million customers in the greater San Jose area, to request assistance in marketing the Program. It also contacted municipal retailers in the cities of Morgan Hill, Gilroy, and Milpitas with a similar request based on the high proportion of their customers that are groundwater users. All three retailers agreed to assist. The SCVWD also advertised the Program through its website, which featured a downloadable rebate application (see Appendix D).

- **Rebate Notice Included in Water Bills** – Starting in March 2004, the San Jose Water Company (SJWC) placed two lines of text notifying customers about the Program in its water bills for two consecutive billing periods (see Appendix E). The SJWC also contacted 29 water softener owners it had previously identified and sent 737 letters about the Program to customers with a

high level of water hardness. Water retailers for Morgan Hill and Gilroy promoted the Program by posting a copy of the rebate form at their customer service desks visible to those customers paying their water bills in person. These marketing efforts ended on June 30, 2004.

Beginning in April 2004, the SCVWD saw a gradual increase in the number of applicants for the Program, with participation peaking in the July-August period. When only 145 of the intended 400 rebates had been allocated by the original May 31, 2004 deadline for applications, the SCVWD chose to extend the deadline, first until July 31, 2004 and then indefinitely until Program funds were depleted. The final, 400th Program application was approved in November 2004.
Figure 6 below details the month-by-month totals of applications approved by the SCVWD.

Figure 6. Rebate Applications Approved by Month



Source: SCVWD Pilot Water Softener Rebate Program records

Table 2 details the tasks and associated costs for this phase.

Table 2. Marketing Phase Tasks

Task	Cost
Conduct Public Meeting	$3,274
Produce and Send Direct Mailing	$2,795
Meet and Contact Water Retailers	$276
Total	***$6,345***

Source: SCVWD Pilot Water Softener Rebate Program records

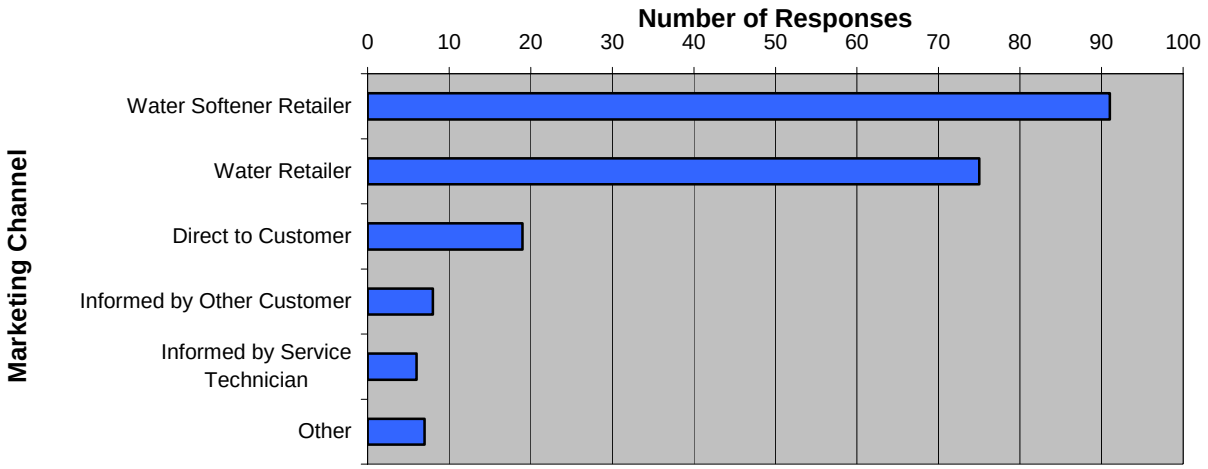
1.3.4 Evaluations

The SCVWD's activities promoting the Program can be categorized into three different marketing 'channels':

- **Through Water Softener Retailers** – Advertisement of the Program by specialty retailers of water treatment technology and general supply retailers.
- **Through Water Retailers** – Advertisement of the Program by three water retailers, including most significantly the San Jose Water Company (SJWC). A substantial number of Program participants are within the service area of SJWC, as shown in Appendix M**.**
- **Direct to Customer** – Initial direct mailing to 1,200 selected water softener owners.

As detailed above, the SCVWD's initial focus on the direct channel, as well as independent steps by retailers of water softeners, did not generate the desired level of customer participation. Only after SJWC began advertising the Program in its March 2004 billing cycle did participation rates begin to climb sharply. Soon after the completion of the Program, the SCVWD conducted a survey of the participants, achieving a response rate of over 50% (206 of 395[3] households as of May 15, 2005). The survey yielded a number of interesting data points on marketing channel effectiveness (Figure 7).

Figure 7. Marketing Channel Effectiveness



The survey results indicate that the first two channels discussed below were the most successful, but for different reasons.

- **Water Softener Retailer Channel – Unknown Number of Customers Contacted** – While the number of customers informed of the Program was relatively small, each had a strong interest in purchasing a water softener, as they were visiting the retail outlet, and were thus highly likely to participate in the Program.

- **Water Retailer Channel – One Million Customers Contacted** – This channel reached the largest customer pool by far with the added advantage of featuring a cost-saving technology on customer water bills. Actual rebate Program data indicate that 60% of participants were located in the SJWC service area. Note that advertising for the Program was limited to a few lines of text on the SJWC bill, issued bimonthly for two cycles.

[3] Five of the original 400 households changed ownership, and could not be reached for survey mailing.

- **Direct to Customer Channel – 1,200 Customers Contacted** - To achieve the SCVWD's goal of 400 rebates would have required a 33% response rate from this customer pool. Based on results from the Santa Clara County Residential Water Use Baseline Survey, 17% of the single-family residents studied and 3% of the multi-family residents studied own a water softener. Survey results indicate that the actual rate of participation among the targeted group of 1,200 water softener owners was about 9%.

1.4 *Operations Phase*

1.4.1 Description

As noted earlier in the research and design evaluation, a customer's experience in applying for and receiving a rebate can make a significant difference in their overall satisfaction with the Program and their willingness to recommend it to others. The operations phase of the SCVWD Program followed a step-by-step order fulfillment process. A number of Program participants had positive comments on their experience with this process. The process, costs involved on an initial and per-customer basis, and customer reactions are discussed below.

1.4.2 Order Fulfillment Process

- Customer calls in or sends in rebate application.
- SCVWD staff records customer information and determines eligibility for rebate and schedules appointment for inspection to confirm ownership of old, self-regenerating water softener.
- Two SCVWD staff members visit customer residence to conduct pre-inspection. SCVWD policy requires two staff members to conduct inspections for safety reasons.
- Customer purchases new DIR water softener and has it installed. *Note: Some 150 customers who received a pre-inspection and were qualified for the rebate did not send in a rebate form. Anecdotal evidence suggests that these customers chose not to buy a new water softener due to cost*. SCVWD staff contacted approximately 20% of these 150 customers and found the main reasons they chose not to buy were high cost, difficulty of electrical wiring, or change of house ownership. A few customers doubted the longevity of the newer softener models.
- Customer sends in completed rebate form with original UPC code and receipt or a copy of the receipt. This step replaced prior plans for a post-inspection soon after the Program's start, saving staff time and serving the same purpose by confirming the purchase of a DIR softener.
- SCVWD staff submits information for qualifying customers to finance office.
- SCVWD finance office issues a rebate check to customer.

SCVWD interns performed almost all tasks associated with order fulfillment including pre-inspections, which were the most time-consuming part of the process. Table 3 outlines the costs of this process on a total and per-customer basis assuming 400 customers served. Note that the per-customer numbers for the Scheduling and Inspections task are somewhat inflated. The SCVWD staff interacted with more than 400 customers during this task including, significantly, the 150 receiving pre-inspections who did not apply for a rebate.

Table 3. Operations Phase Tasks

Task	*Total Cost*	*Cost per Customer*
Initial Preparation (hiring intern, creating database, etc.)	$914	$2.29
Scheduling and Inspections	$24,300	$60.75
Processing Rebates	$5,684	$14.66
Preparing and Administering Survey	$2,836	$7.09
Total	***$33,914***	***$84.79***

Source: SCVWD Pilot Water Softener Rebate Program records

1.4.3 Follow-Up Customer Survey

In order to fully evaluate the Program benefits, a survey was mailed to 395 of the 400 rebate applicants. A fact sheet explaining the difference between using potassium chloride (KCl) as opposed to sodium chloride (NaCl) for water softener regeneration was enclosed in the survey (see Appendix F). The main purpose was to inform customers of the environmental benefits of using KCl. The results indicated that the Water Softener Retailer Channel (unknown number of customers contacted) and the Water Retailer Channel (one million customers contacted) were the most efficient marketing channels.

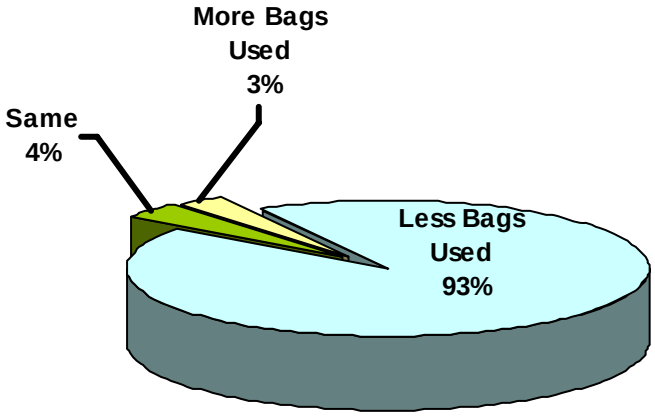
In general, customer satisfaction with the application process was high. Results from the survey show that of the 206 participants who responded, many complimented the organization and the courtesy of the operations fulfillment staff. In addition, feedback from respondents indicated a significant reduction in salt consumption for water softener regeneration. The *Customer Salt Savings* section of this report summarizes the results of this survey. Two questions from the survey regarding customer salt consumption reduction are listed below:

- Based on your observations, do you use more or fewer bags of salt for your new water softeners?
- Approximately how many bags of salt do you use per month for your water softener?

Out of the 206 survey respondents, 66, or 32%, provided comments. A review of these found the following:

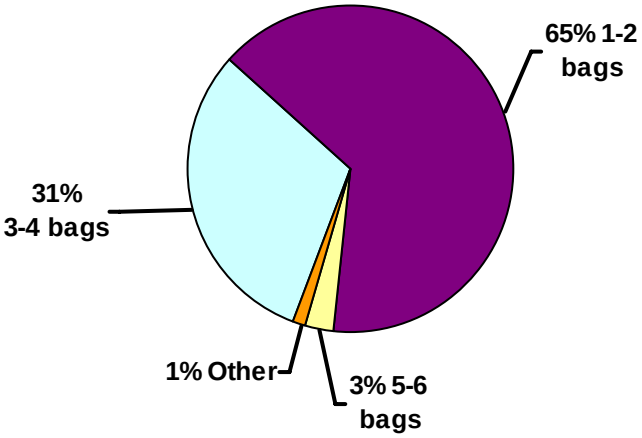
- 50% of the comments could be categorized as positive and complimentary.
- 20% commented on the potassium chloride (KCl) fact sheet contained with the survey form or on the use of potassium chloride as a substitute for salt, with most thanking the SCVWD for the new information.
- 15% suggested more publicity for the Program.
- Six respondent comments, or 9% of the total, were negative, either expressing frustration with the application process or questioning the need for two inspectors to perform the pre-inspection.
- 93% used less bags of salts, 4% used the same, and 3% used more bags of salt (see Figures 8 and 9).

Figure 8. Percentage of Salt Bag Reduction from Customer Feed Back Survey



- Of the 93% that used less bags of salt, the percentage breakdown of the number of bags used per month is listed below:

Figure 9. Percentage Breakdown of Number of Bags Used Per Month



A copy of the survey is provided in Appendix F.

The SCVWD survey also yielded information on salt saved as a result of Program participation. This information is discussed further in the savings analysis section that follows.

2. PROGRAM SAVINGS, BENEFIT COST ANALYSES

2.1 *Introduction*

The following section presents savings estimates on water, energy, and salt as a result of the Program. The analyses and evaluations of the Program based on the savings computed are included.

2.2 *Water Savings*

The estimation of water savings attributable to the Program is calculated based on (1) actual participants' water billing data, and (2) water softener manufacturer's data for regeneration. The two methods are discussed in detail below:

2.2.1 Method 1

Water savings from this Program can be estimated by calculating the difference in consumption before and after the installation of the new water softener. This method works only if the only difference in water use between pre- and post-installation is due to the new softener.

From an economic perspective, this would be the marginal savings of the Program, or the savings estimate that can be attributed to the Program. There are several ways to calculate marginal savings. Due to data constraints the following method was used: (1) calculate the monthly percentage difference of consumption between pre- and post-installation; and (2) multiply the percentage savings by the prior consumption. Formula 1 shows this calculation.

Formula 1: Theoretical Calculation of Savings Estimates

$$\text{Percent Savings}_{m\,i} = [C_{(post)\,m\,i} - C_{(prior)\,m\,i}] / C_{(prior)\,m\,i}$$

$$\text{Savings Estimate}_{m\,i} = \text{Percent Savings}_{m\,i} * C_{(prior)\,m\,i}$$

where:

$C_{(prior\ year)}$ = consumption year prior to the installation
$C_{(post\ year)}$ = consumption year post-installation
M = month
i = account of the water softener participant

There are two uncertainties associated with the use of Formula 1 for calculation of the water savings estimate. First, there are many exogenous factors that could change over time, such as weather. Since weather conditions are not consistent each month, Formula 1 would produce a biased estimate. For instance, if the year prior to the installation of the water softener was a dry year and the year after installation was a wet year, the estimate of the savings would have an upper-bound bias. Dry years are associated with a high demand of water and wet years are associated with low demand of water, due to outdoor irrigation. Thus the difference in weather conditions would result in an incorrect savings estimate. To correct for this factor a control group is used: a group of single family residential houses who are not participating in the Program but are affected by the same weather. The ultimate control group would be at least the same size as the participants (400) and randomly selected. Formula 2 shows how to calculate the savings estimate by factoring in exogenous changes.

Formula 2: Calculation of Savings Estimate with a Control Group

$$\text{Percent Savings}_{m\,i} = [C_{(post)\ m\,i} - C_{(prior)\ m\,i}]/C_{(prior)\ m\,i} - [C_{(post)m\,a} - C_{(prior)m\,a}]\ /C_{(prior)m\,a}$$

$$\text{Savings Estimate}_{m\,i} = \text{Percent Savings}_{m\,i} * C_{(prior)\ m\,i}$$

where:

$C_{(prior\ year)}$ = Consumption prior to the installation
$C_{(post\ year)}$ = Consumption post installation
m = Month
i = Account of the water softener participant
a = Account of the water softener in the control group

The second uncertainty is that the percentage savings estimate is multiplied by the consumption in a specified month of the year prior to installation. Depending on the month selected, the water consumption may reflect a significant amount of outdoor water use. For instance, on average 50% of all water use in Santa Clara County is for outdoor water uses. To further control for outdoor water use, the analysis should focus on wet months, i.e., months that have little or minimal outdoor water use. The ideal month would be February or January, when rainfall is highest. The formula in Formula 2 would yield a savings estimate that is not biased if estimated for the month of February, since it is controlling for other exogenous factors.

2.2.1.1 Tools

Since the Program reached customers in over eight different retail agencies, a significant amount of time was needed to gather the billing data of participants into a database. Once this database was organized, the savings are estimated by using Formula 2. The database was originally in MS Excel and was formatted wide[4]. The database was manually converted into STATA 8, using DBMS Copy. Once the database was in a STATA format, the file was reformatted to be long[5]. Appendix G shows the log file or carbon copy file that shows the steps taken to reformat and clean the database. Once the data was correctly formatted, the savings estimate was performed (Appendix H).

2.2.1.2 Assumptions

As mentioned, an ideal control group would be at least the same size as the participant group and randomly selected. However, there were problems attaining a proper control group due to confidentiality constraints. Although all water softener participants signed a waiver of confidentiality that allows us access to their billing data, there was no legal documentation for the hypothetical control group. Due to this constraint the percentage difference in total residential water use for the SJWC between the same months in 2003 and 2004 was used.

In addition, there was a time constraint in collecting billing data. As noted, eight different retail agencies participated in the Program. The need to organize the collection of billing data from these eight agencies was a lengthy process; as a result only data for the month of December, not for the ideal month of February, was available for analysis.

[4] Wide format – Each row represents one unique account, and the read dates of the consumption variable moves across columns. Note that the number of reads for each account is different.
[5] Long format – Multiple rows contain readings of the account, however each row includes only one variable for consumption. The number of rows of data is equal to the number of reads times the number of unique accounts in the wide format.

2.2.1.3 Constraints

There are three major constraints in this analysis of the water savings estimate. The first is the use of the total residential water use of the San Jose Water Company as the control group. This figure includes consumption of both single-family and multi-family customers. All the participants of the Program were single-family customers. This mismatch of customer type could bias the savings estimate.

The volatility of water sales for multi-family customers is usually less than that for single-family customers due to the fact that single-family customers have proportionately larger outdoor water use. Multi-family water use is usually primarily indoor water use. Thus the combination of single-family and multi-family accounts would have a lower variance than only single-family accounts. This lower variance means that the estimates on savings could be biased. The magnitude of this bias is difficult to determine given the current data available.

The second major constraint is other conservation programs currently implemented in Santa Clara County. This analysis assumes that the Program is the sole source of the saving estimates. If participants are concurrently engaged in other water rebate programs, however, the saving estimates will be determined by a variety of rebate programs. The magnitude of this problem is difficult to predict since there is no centralized information on participants in different conservation programs.

The third major constraint is the use of the month of December for the analysis. There are two problems with this. The first is that people tend to travel during this month for the winter holidays. Since traveling is correlated with income, water consumption could change based on economic conditions in Silicon Valley. For instance, if people did not travel in 2003 due to the recession, but traveled in 2004 due to higher expected income, there could be a reduction in water use for the month of December based solely on the economic conditions in Silicon Valley.

The second problem with using the month of December is due to outdoor water use. As mentioned, the savings estimated are based on the prior consumption month. If this base consumption contains outdoor water use, we could overestimate the savings from the Program. To correct for this, an indoor/outdoor water use factor (discussed in Section 2.2.2.3) was used.

2.2.2 Results of the Analysis

2.2.2.1 Description of Data

The data set provided contained data for 367 of the 400 customers participating in the Program. Table 4 below shows the number of observations (consumption figures) per month and year.

Table 4. Number of Observations by Month and Year

Month	Year	
	2003	***2004***
January	212	221
February	175	184
March	213	234
April	188	192
May	226	226
June	180	206
July	224	234
August	200	180
September	200	219
October	203	187
November	176	206
December	194	181

Note that even though there are 367 customers, the number of observations per month is always less than this total, often substantially. There is not information for each customer for each month due to two factors: (1) some retail agencies use bimonthly billing cycles; and (2) time series are inconsistent. In order to calculate the savings effect of the Program a consistent time series of data is needed. Appendix I shows the water retail agencies, the associated accounts, and the missing years and month in the time series.

In addition, there were eight different retail water agencies represented among participants in the Program. The majority of participants were customers of the SJWC. Table 5 shows the distribution of participants according to water retailer.

Table 5. Distribution of Observations by Water Retailer Agency

Retail Water Agency	Observation Frequency	Percentage of Total	Cumulative Percentage
California Water Services Company	543	8%	8%
Gilroy Community Services Department	140	2%	10%
Great Oaks Water Company	645	9%	19%
City of Morgan Hill	302	4%	23%
San Jose Municipal Water System	108	2%	25%
San Jose Water Company	4,167	60%	85%
City of Santa Clara Water Department	762	11%	96%
City of Sunnyvale Public Works Dept.	256	4%	100%

2.2.2.2 Control Group

Table 6 shows the total residential water consumption for the SJWC for December in 2003 and 2004. Water consumption fell by 14%. This means that if the Program was completely ineffective, there would be a 14% reduction in water consumption for the participants. If the consumption percentage difference is not equivalent to this figure, then the difference can be attributed to the Program.

Table 6. Control Group Change in Water Consumption for December

	2003	2004	Percentage Difference
San Jose Water Company Total Residential Consumption (CCF)	2,705,785	2,336,828	-14%

2.2.2.3 Estimated Water Savings

To calculate the savings estimate, the average daily consumption of water for December 2003 and December 2004 was calculated. This only includes accounts with data for both December 2003 and December 2004 and for which an installation of a water softener occurred in that timeframe. The percentage difference between the years was then calculated and adjusted for the control group percentage difference. The calculation shows that the participants had an additional 4% reduction of water consumption when compared to the control group. This reduction can be attributed to the Program.

Table 7. Estimated Percentage of Water Savings

	2003	2004	Percentage Difference	Control Group Percentage Difference	Estimated Percent Savings
Daily Water Consumption (CCF)	0.429	0.353	-18%	-14%	**-4%**
Daily Water Consumption (gallons)	321	264	-18%	-14%	**-4%**

Following the steps in Formula 2 the estimated percent savings is multiplied by the prior consumption. As mentioned, the prior consumption may contain outdoor water use. To control for this, an outdoor/indoor ratio is used as shown in Table 8.

Table 8. Adjustment for Indoor/Outdoor Water Use

Daily Water Consumption in December 2003 (CCF)	Percent That Is Outdoor Water Use	Indoor Water Use (CCF)	Estimated Percent Savings	Estimated Savings per Day (CCF)	Estimated Savings per Day (Gallons)
0.429	0%	0.429	-4.2%	-0.018	-13.6
0.429	10%	0.386	-4.2%	-0.016	-12.2
0.429	**20%**	**0.343**	-4.2%	**-0.015**	**-10.9**
0.429	30%	0.301	-4.2%	-0.013	-9.5
0.429	40%	0.258	-4.2%	-0.011	-8.2
0.429	50%	0.215	-4.2%	-0.009	-6.8

Currently there is no available information on the ratio of outdoor/indoor water use in December. The standard assumption is that 10% of the water use in February is for outdoor irrigation. The SCVWD's assumption for the month of December is that outdoor water is 20% of the total. The SCVWD considers this to be a conservative estimate, given the level of rainfall that occurred in December 2003. With this factor, the estimated daily water savings of the Program is 0.015 CCF, or 10.9 gallons. This is a monthly savings of 0.436 CCF, or 326 gallons, which translates into yearly savings of 3,972 gallons per customer per year.

The declining performance of water softeners' efficiency is not different from other home appliances. In order to account for performance deficiency in the water savings estimate, a deficiency rate of 2.5% is applied starting in the fourth year over the equipment life span of 20 years. The calculated average water savings estimate works out to 1,321,910 gallons, or 1,770 CCF, per year. Over a 20-year timeframe, the total savings estimate is 26,438,205 gallons, or over 35,000 CCF. Table 9 shows the adjusted annual water savings of the Program using Method 1.

Table 9. Adjusted Annual Water Saving Calculated in Method 1 with Declining Efficiency Rate of 2.5% Applied Starting in the Fourth Year

Year	Water savings per customer (gallons)	Total Water Savings (gallons)
1	3,972	1,588,800
2	3,972	1,588,800
3	3,972	1,588,800
4	3,873	1,549,080
5	3,776	1,510,353
6	3,681	1,472,594
7	3,589	1,435,779
8	3,500	1,399,885
9	3,412	1,364,888
10	3,327	1,330,765
11	3,244	1,297,496
12	3,163	1,265,059
13	3,084	1,233,432
14	3,006	1,202,597
15	2,931	1,172,531
16	2,858	1,143,218
17	2,787	1,114,638
18	2,717	1,086,772
19	2,649	1,059,603
20	2,583	1,033,113
Total Water Saving Over the Equipment Life of 20 Years		**26,438,205**
Average Annual Savings		**1,321,910**

2.2.3 Method 2

The second method used to estimate the water savings is based on the result of customers' feedback on the survey form that were sent to the 400 Program participants, the manufacturer data with regards to the regeneration specification, and random interviews with customers during the Program pre-inspections. It is estimated that DIR water softeners would require approximately 7 times less regenerations per month than timer-based softeners. In addition, the following assumptions are made for the calculation of the water savings estimate:

1. The number of regenerations for timer-based water softeners is 14 times per month, and for a DIR water softener is 7 times per month.
2. The amount of water used per regeneration is calculated based on the average of the most popular models purchased
3. The amount of water needed for regeneration is the same for timer-based water softeners and DIR water softeners.
4. Water softener brands and models other than Kenmore that participants purchased have the same regeneration specification as the Kenmore models.
5. Equipment life is 20 years.
6. Water softeners' performance efficiency begins to reduce at the annual rate of 2.5% starting in the fourth year after the equipment is in operation.

2.2.4 Results of the Analysis

2.2.4.1 Description of Data

Approximately 50% of the water softeners purchased by the Program participants were made by Kenmore. Based on the manufacturer's data, the amount of water used for regeneration for each model is calculated and shown in Table 10.

Table 10. Amount of Water Used per Regeneration for the Most Popular Water Softener Models Purchased by Program Participants

Kenmore Model	Water Used per Regeneration (gal)
625.388170	39
625.388180	39
625.388250	39
625.388270	48
625.388275	48
625.388280	48
625.388400	44
625.388450	44

The estimated average water savings for these water softener models is 43 gallons per regeneration. The estimated overall water savings is computed at 1,444,800 gallons per year. The water savings calculation is shown in Table 11.

Table 11. Water Savings Estimate-- Method 2

Estimated number of regenerations for timer-based water softeners (per month)	14
Estimated number of regenerations for DIR water softeners (per month)	7
Average water used per water softener regeneration (gallons)	43
Average monthly water saving per regeneration per customer (gallons)	301
Average annual water saving per customer (gallons)	3,612
Total annual water saving from the Program (gallons)	1,444,800

A deficiency rate of 2.5% is applied starting in the fourth year over the equipment life span of 20 years. Thus the calculated average water savings estimate works out to 1,202,100 gallons per year. Table 12 shows the adjusted annual water savings of the Program using Method 2.

Table 12. Adjusted Annual Water Saving Calculated from Method 2 with Declining Efficiency Rate of 2.5% Applied Starting in the Fourth Year

Year	Water savings per customer (gallons)	Total water savings (gallons)
1	3,612	1,444,800
2	3,612	1,444,800
3	3,612	1,444,800
4	3,522	1,408,680
5	3,434	1,373,463
6	3,348	1,339,126
7	3,264	1,305,648
8	3,183	1,273,007
9	3,103	1,241,182
10	3,025	1,210,152
11	2,950	1,179,899
12	2,876	1,150,401
13	2,804	1,121,641
14	2,734	1,093,600
15	2,666	1,066,260
16	2,599	1,039,604
17	2,534	1,013,613
18	2,471	988,273
19	2,409	963,566
20	2,349	939,477
Total water saving over the equipment life of 20 years		**24,041,993**
Average Annual Savings		**1, 202,100**

2.2.4.2 Uncertainties

There are three uncertainties associated with the use of the Method 2 for the calculation of the water savings estimate. The first uncertainty is the frequency of regenerations per month for the existing timer based water softeners. Based on customers' responses during the Program's pre- and post-inspections, the older water softeners had regeneration rates that varied from once every day to once every three days. The water savings estimate may vary if the assumption is different. The second uncertainty is that the initial water hardness settings in the equipment vary from the source of water supplied to the participants and the seasonal fluctuation of the source water and hardness level. An appropriate water hardness setting in a water softener is the most critical factor in obtaining the optimized result. The third uncertainty is that the customer may change the water hardness setting to fit their needs. These uncertainties may change the water savings estimate calculated in Method 2.

2.3 Salts Discharged to Sewer System Reduction Estimate

As mentioned in the previous section, the average salt used for DIR water softener regeneration is estimated to be at least one bag of 50 lbs salt less than timer-based water softeners. As a result, approximately 240,000 lbs of salts annually have been reduced that would otherwise be discharged to the local sewer system. The summary of salt usage reduction is summarized in Table 13 as follows:

Table 13. Salt Reduction Estimate

Average number of regenerations for timer-based water softeners (per month)	14
Average number of regenerations for DIR water softeners (per month)	7
Average monthly reduction of salt used per customer (lbs)	50
Average monthly reduction of salt discharged to sewer system (lbs)	20,000
Total annual reduction of salt discharged to WWTP (lbs)	**240,000**

The reduction of salts being discharged to the local sewer system is beneficial to the environment and the use of recycled water because of lower concentrations of sodium, chloride, and total dissolved solids (TDS) in recycled water. These benefits, however, are unable to be quantified for the cost-benefit ratio evaluations analyzed in the following section.

2.4 *Other Savings Estimates*

The computation on savings estimate of avoided cost on new water purchase, wastewater treatment operation cost and customer water savings is based on results from Method 1. Both Methods 1 and 2 yielded similar water savings (Method 1 = 26,438,205 gallons and Method 2 = 24,041,993 gallons), however Method 1 is based on actual water consumptions observed from the participants' water bills one year prior and one year post installation of customer's water softener. Thus the results from Method 1 are considered more applicable to the Program savings analysis.

2.4.1 Cost Savings Estimate to the SCVWD

As found in Section 2.2.2.3, the calculated annual water savings of the Program is 1,321,910 gallons, or about 4.1 acre-foot. Based on the estimated avoided cost of $430 per acre-foot of water conserved, the cost savings to the SCVWD is $1,744 per year. Table 14 illustrates the saving calculations.

Table 14. Cost Savings Estimate to the SCVWD

Program's Yearly Water Savings (Gallons)	Yearly Savings (AF)	SCVWD Avoided Cost of Water ($/AF)	Yearly Program's Cost Savings Estimate
1,321,910	4.1	$430.00	$1,744

2.4.2 Savings Estimate on Wastewater Treatment Operation Cost

At the San Jose/Santa Clara Wastewater Treatment Plant, the average AF cost to treat water is assumed to be $400 per acre-foot. As calculated water savings estimate in the previous section, the average annual water savings value from the Program is 1,321,910 gallons or 4.1 AF per year. This gives total yearly savings of $1,623 per year. Table 15 shows this calculation.

Table 15. Saving Estimate in Wastewater Treatment Plant Operation Cost

Program's Yearly Water Savings (Gallons)	Yearly Savings (AF)	Wastewater Treatment Cost ($/AF)	Total Yearly Savings Estimate
1,321,910	4.1	$400.00	$1,623

2.5 *Customer Savings*

This section estimates the customers' monetary savings on water and salt purchases as a result of the Program. The calculations of these savings are summarized as following:

2.5.1 Customer Water Savings

With the estimated annual water savings of 1,321,910 gallons, the monetary savings of a typical customer can be calculated. Table 16 shows the results. As there were 400 participants, the Program is estimated to save 4.44 CCF per year. The SJWC charges $1.9901 per CCF per customer, which is a savings of $8.80 per year per customer.

Table 16. Customer Monetary Water Savings Estimate

Yearly Savings (CCF)	San Jose Water Company Rate (per CCF)	Savings Per Year
4.44	$1.9901	$8.80

2.5.2 Customer Salt Savings

Besides water savings, there are also salt savings from the Program. The savings estimate is based on the survey of participants (Appendix F). From the results of the survey it is estimated that 50 lbs of salt is saved each month by Program participants with their new DIR softeners. With 40 lbs of salt costing $5[6], this results in savings of $75 per year, as shown in Table 17.

Table 17. Customers' Salt Savings Estimate

Salt savings per month (as per survey) (lbs/month)	Cost of Salt (40 lbs)	Yearly Savings from Salt Reduction
50	$5.00	$75

[6] http://www.homedepot.com

3. BENEFIT-COST RATIO ANALYSES

One of the methods to evaluate a program or project's cost effectiveness is to a compute benefit-cost ratio. If the ratio is greater than one, this means that the benefit exceeds the cost and the program is cost-effective. The converse is also true; a ratio below one means the cost exceeds the benefits and the program is not cost effective.

The following section calculates the benefit-cost ratio with respect to the Program's participants and the SCVWD for the evaluation of the Program's cost effectiveness.

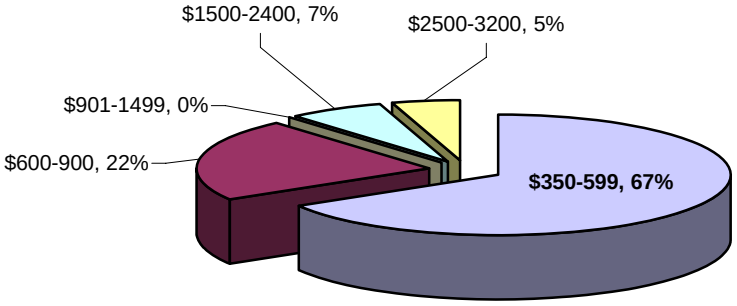
3.1 *Benefit-Cost Ratio to Customers*

Based on the rebate application forms submitted by the participants, the average cost and brands of new water softeners purchased by the participants are summarized in Table 18. The price range of the water softeners purchased is also illustrated in Figure 9.

Table 18. Cost of DIR Water Softeners to Participants

	Number of Participants	Total Cost by Make
Culligan	16	$38,400
General Electric	53	$23,850
Kenmore 100 – 800 series	217	$99,448
Kinetico	19	$36,870
Randazzo's	59	$47,200
Serv-All Autotrol	16	$12,000
Others	20	$30,450
Total	**400**	**$288,218**

Figure 10. Price Range of Water Softeners (Data from Program Participants)



3.1.1 Customer Cost

The Program cost is $135,168, which includes the rebate and administration cost. The total purchase cost of the water softeners is $288,218. To calculate the actual cost to the customers, the cost of the rebate received from the funding agency ($60,000) is subtracted from the water softeners purchased ($288,218), which imposes $228,618 as the cost to the customers.

The total cost to the customers is summarized in Table 19 below.

Table 19. Net Water Softener Costs to Customers

Total Cost of Water Softeners	Rebate Cost	Total Cost to Customers
$288,218	$60,000	**$228,218**

3.1.2 Customer Benefits

The first portion of Table 20 calculates the present value (PV) of benefits to customers from water bill savings. Based on the customer water bill savings of $8.80 per year per customer, it yields a PV of $77,264 with 400 participants at a discount rate of 4% over twenty years. The second portion of this table calculates the customer savings from reduced salt purchases. The annual savings, as mentioned, is $75. The same discount rate of 4% applied over a twenty year period for 400 participants will yield a PV of $398,045. The total PV benefit to customers from this Program is then $475,309, and the PV of the cost to customers is $228,218 (see Appendices J and K for the calculations). The benefit-cost ratio is 2.08, which is significantly higher than 1, indicating that the Program is cost-effective.

3.1.3 Cost Effectiveness to Customers

Table 20. Customer Benefit-cost ratio

Customer Benefit-cost ratio	
Water Savings	
Savings Per Year	$8.80
Number of Participants	400
Present Value	$77,264
Salt Savings	
Savings Per Year	$75
Number of Participants	400
Present Value	$398,045
Total Present Value of Benefits	*$475,309*
Total Present Value of Costs	*$228,218*
BENEFIT-COST RATIO	**2.08**

3.2 *SCVWD Benefit-Cost Ratio*

By combining the internal savings estimate above with total Program costs figures, the SCVWD produced an estimate of the cost effectiveness of the Program, which is a benefit-cost ratio. Note that the estimates in Table 21 focus only on the benefits from cost savings for groundwater pumping and water treatment, and does not include the savings from wastewater treatment.

3.2.1 SCVWD Cost

The overall Program cost to the SCVWD is $75,168, which is arrived at by subtracting the rebate cost ($60,000) from the Program cost ($135,168). As shown in Table 21, the calculated net present value of the Program cost to the SCVWD is -$39,963 (water savings – total Program cost) at a discounted rate of 4% over 20 years.

3.2.2 SCVWD Benefit

The avoided cost to the SCVWD for the purchase of water as a result of water savings from the Program is estimated at $430 per acre-foot, which includes the costs of conveyance, treatment, and pumping. The installed water softeners are assumed to yield different water savings over the twenty-year period beginning in the fourth year to account for the possibility of diminishing effectiveness at a 2.5% equipment efficiency discount, of the water softener's DIR system over time. Table 21 illustrates the benefit-cost ratio (see Appendix L for computation).

Table 21. Benefit-cost ratio to the SCVWD

Benefit-cost ratio to the SCVWD	
Total adjusted water savings over 20 years (gallons), from Method 1	26,438,205
Avoided water cost ($/acre-foot)	$430
Water savings over 20 years (acre-foot)	81
Undiscounted water savings cost over 20 years	$48,481
Discounted water savings cost over 20 years	$32,314
Total Program cost to SCVWD (discounted; occurs in year 1)	$27,277
Net present value	-$39,958
BENEFIT-COST RATIO	**0.45**

3.2.3 Cost Effectiveness to the SCVWD

Based on the computed benefit-cost ratio, the Program was not cost-effective for the SCVWD because the ratio is significantly below one. There are other benefits of this Program, however, that are not captured such as the reduction of overall volume of wastewater generated, the reduction of sodium, chloride, and total dissolved solids, and other environmental benefits that make the Program more cost-effective.

4. OTHER BENEFITS

This benefit-cost ratio estimate does not include the monetization of the following benefits:

- Reducing demand for water imported from the Bay-Delta to urban water agencies.
- Reducing the introduction of TDS, detergents, and other cleaning compounds into wastewater flows and potentially to ground and surface water supplies that are part of the Bay-Delta ecosystem.
- Saving the Bay-Delta ecosystem an increment of environmental damage resulting from energy production and distribution, as the new water softeners are also more energy efficient.
- Developing cost-effective programs to reduce TDS and other contaminants to speed the introduction of these technologies and their benefits to the Bay-Delta watershed at large.
- Increasing the quality of recycled water, which can be used for irrigation.
- Reducing customer energy bills and reduced water heater repairs due to the decrease in scaling.

5. RECOMMENDATION

5.1 *Overall*

Over the next five years and beyond, participants should continue to benefit from reduced water consumption. The generation of new consumption data each year provides the opportunity to achieve a more robust estimate of water savings. To develop such an estimate the SCVWD should take the following steps:

- Continue to collect participant consumption data in partnership with retail water agencies.
- Continue to provide public education on water softeners, and public information with regards to potassium chloride and water quality.
- Establish a proper control group. This would consist of at least the same number as Program participants (400) of randomly selected single-family dwelling units with the same distribution among retail water agencies as shown in the “Distribution of Observations by Retail Water Agency” Table 5 .
- Collect weather data to establish control group. Once this information is collected, one can perform a fixed effect regression to estimate the water savings for each brand of water softener.

5.2 *Research and Design Phase*

Given the complexity of determining an optimum rebate amount, the SCVWD’s findings on water softener costs and the desire for a large sample size, the $150 amount was a reasonable choice. However, to improve the Program in the future, the SCVWD would:

- Review data on the Program participants to determine the most common product type used and its cost, and adjust the rebate amount as needed.
- Modify the customer survey used in the Water Wise House Call program and in future studies to capture the type of water softener used, namely DIR or timer-based.

5.3 *Marketing Phase*

The SCVWD's experience with marketing the Program contains lessons for future rebate programs. The proactive response from the SCVWD staff to the limited number of participants in the first four months made a significant improvement in response rate when water retailers joined the promotion effort. To improve the Program in the future, the SCVWD would:

- Actively recruit water retailers from the beginning of the promotion effort and encourage all to insert a notice in water bills mailed to customers (and not limit their efforts to the posting of a rebate form at in-person customer payment counters). If funding allows, the SCVWD may also consider paying for an insert flyer in water bills as an effective added advertisement in addition to lines of text on the bill.

- Provide water softener retailers, both specialty and general, with promotional materials on the Program in electronic form suitable for reproduction and mailing to their customer lists.

5.4 *Operation Phase*

Overall, the operations process went smoothly. However, the details above suggest several possible improvements to reduce costs and staff time needed for the Scheduling and Inspections task. To improve the Program in the future, the SCVWD would consider the following actions:

- **Inform customers of the cost range for new DIR water softeners prior to scheduling a pre-inspection, and emphasize the DIR purchase requirement** for receiving a rebate. This step should help limit the number of customers receiving inspections who decide not to purchase a new water softener and do not apply for a rebate, and those who apply but don't qualify for a rebate.

- **Provide a Potassium Chloride (KCl) fact sheet to customers as part of the inspection process** prior to their purchase of a new water softener, and provide an initial supply of softening agent (typically this is the lower cost sodium chloride, or NaCl, common salt).

- **Provide information on the hardness rating of the customers water as part of the pre-inspection process** so that hardness settings on new DIR water softeners can be adjusted to match, providing a further reduction in salt usage.

- **Revisit the 150 customers who received pre-inspections but did not file rebate applications** to encourage their participation**.**

6. Appendix A. Public Meeting Notice

public meeting

topic **Two California Department of Water Resources grant projects**

who Santa Clara Valley Water District

what **public meeting**

when **June 12, 2003, 6-8 p.m.**

where Santa Clara Valley Water District Board Room
5700 Almaden Expressway
San Jose, California

why You are invited to attend an informational meeting regarding two projects: The Water Softener Pilot Rebate Program and the Dedicated Landscape Meter Installation Program. Both the projects aim to reduce the demand for water imported from the Bay-Delta and conserve water in Santa Clara County.

Estimated costs for each program: The Water Softener Pilot Rebate Program will cost $103,927 with $60,000 from a Proposition 13 Urban Water Conservation Capital Outlay Grant; and the Dedicated Landscape Meter Installation Program will cost $202,000 with $100,000 from a Proposition 13 Urban Water Conservation Capital Outlay Grant.

The Santa Clara Valley Water District would appreciate your input on these two projects at the hearing. The purpose of this hearing is to inform the community of these projects and provide a forum for public comment. Written comments may also be submitted in advance to Associate Engineer Ray Wong, Santa Clara Valley Water District, 5750 Almaden Expressway, San Jose, CA 95118.

For more information about this meeting and these projects, please contact Ray Wong of the Water Use Efficiency Unit at (408) 265-2607, ext. 2288.

7. Appendix B. Letter Used for Direct Mailing

Santa Clara Valley Water District

5750 ALMADEN EXPWY
SAN JOSE, CA 95118-3686
TELEPHONE (408) 265-2600
FACIMILE (408) 266-0271
www.valleywater.org
AN EQUAL OPPORTUNITY EMPLOYER

November 7, 2003

Dear Customer,

Are you interested in saving water, energy, and money? The Santa Clara Valley Water District is offering $150 rebate, limited time offer, for the replacement of an existing, operating timer-based water softener purchased before November 1999. The water softener must be replaced with a new demand initiated regeneration (DIR) water softener that meets California efficiency rating of at least 4,000 grains of total hardness removal per pound of salt utilized. The new DIR water softener uses less water than a timer based water softener because regeneration is controlled by a meter rather than a timer. When you save water, it saves energy because it takes energy to treat the water and deliver it to your home.
You must set up an appointment to have your existing timer-based water softener inspected to determine if it qualifies. Following the installation of the new water softener you need to schedule a final inspection before you mail in your rebate form. The typical appointment takes less than 15 minutes and is available on Saturdays as well as on weekdays and evenings during daylight hours. **Please take advantage of this rebate program by calling (408) 265-2607 extension 2554 to schedule an appointment.**

Sincerely,

Ray Wong
Program Manager, Pilot Water Softener Rebate Program
Water Use Efficiency Unit

The mission of the Santa Clara Valley Water District is a healthy, safe and enhanced quality of living in Santa Clara County through watershed stewardship and comprehensive management of water resources in a practical, cost-effective and environmentally sensitive manner.

8. Appendix C. Rebate Application Form

Santa Clara Valley Water District

$150 Water Softener Rebate

APPLICATION AND OFFICIAL RULES

Qualifications:

- Applicant must own a currently working timer-based self regenerating water softener installed prior to November 1999.
- The old softener must be replaced with a new demand initiated regeneration (DIR) water softener that meets California efficiency rating of at least 4,000 grains of total hardness removal per pound of salt utilized.
- Installation must be in Santa Clara County.
- After completion of the pre-inspection by SCVWD staff; complete the rebate application form and mail with the original sales receipt and original UPC sticker to: **Pilot Water Softener Rebate Program, Santa Clara Valley Water District, 5750 Almaden Expressway, San Jose, CA, 95118-3614**.
- Offer expires when funds are depleted.
- Offer is limited to one (1) water softener rebate per single family home, condominium, apartment, or mobile home.
- Santa Clara Valley Water District limits this Pilot Rebate Program to residential applications only.
- Santa Clara Valley Water District (SCVWD) reserves the right to verify customer eligibility, water softener sale, and installation before/after a rebate is paid. After installation, the water softener must remain at an eligible site for a minimum of twelve (12) months after the installation date.
- Offer void where prohibited or restricted by Law.
- **Do not submit application until pre-installation inspection has been completed.**

Five Steps to Receive Your Rebate:

1. Before removal of your old softener, call the SCVWD at (408)265-2607 ext. 2554 to set up a pre-installation inspection.
2. Purchase a new eligible water softener.
3. Complete and mail the rebate application form with the original sales receipt and original UPC sticker.
4. After installation of the new water softener, call SCVWD at (408)265-2607 ext. 2554 to set up a post installation inspection.
5. Allow 6-8 weeks for the $150 rebate check to be processed.

FOR YOUR RECORDS

- Keep this stub for your records and follow up inquiries.
- Please allow 6-8 weeks from mailing date for remittance of your rebate check. If your check has not been received after 8 weeks, call the Santa Clara Valley Water District Water Conservation Hotline at **(408) 265-2607 ext. 2554**. Monday through Friday, 8:30 A.M. to 5:00 P.M.
- Santa Clara Valley Water District is not responsible for items lost or delayed in the mail, nor any remittance delayed due to incorrect rebate application.
- Incomplete applications cannot be processed.
- This offer is good **until funds are depleted**.

Date mailed: _____

KEEP THIS PORTION

PILOT WATER SOFTENER REBATE APPLICATION FORM

Please complete all information and mail with the original sales receipt and original UPC sticker in an envelope addressed to:

Pilot Water Softener Rebate Program
Santa Clara Valley Water District
5750 ALMADEN EXPRESSWAY
SAN JOSE, CA 95118-3614

Applicant Information:

Applicant's First Name Last Name

Address (where rebate check should be sent) Apt#

City CA, Zip Code ( ) Telephone Number

Address (where water softener is installed if different from above) Apt#

City CA, Zip Code ( ) Telephone Number

Name of Water Provider

Water Service Account Number

Did you include the original sales receipt and original UPC sticker?
Did you complete all the information in the rebate form?

Softener Information:

___/___/___ Date Purchased $___ Purchase Price

Brand

Water Softener Model Number

Serial Number

Please Note: I certify that this water softener was purchased new at retail price for personal use, not for resale. I agree to sale, delivery and product installation verification by the Santa Clara Valley Water District (SCVWD). I will neither apply for nor accept any other SCVWD cash rebate or incentive for the appliance described on this application. The undersigned expressly agrees that the SCVWD may inspect all qualifying water softener installations; that installation of qualifying water softener may not result in lower water bills; and that the SCVWD does not warrant any water softeners or installation to be free of defects, the quality of workmanship, or the suitability of the premises for the water softener installation. I agree to allow the SCVWD to be given access to the property's water use information for the purpose of evaluating the effectiveness of the Pilot Water Softener Rebate Program. I understand that my water retailer will be supplying the water use information to SCVWD. The undersigned further agrees to hold harmless the SCVWD, its directors, officers, and employees, from all personal injury or injury to property including loss, damage, expense and or liability resulting from the loss, destruction or damage to property arising out of or in any way connected with exchange and installation of a water softener. **I have read, understand, and agree to the terms and conditions of this rebate program including the "Qualifications" and "Please Note" sections of this application.**

X___ Applicant's Signature ___/___/___ Date

FOR OFFICE USE ONLY				
	Pre-Inspection	Date	By	☐ Invoice on file ☐ Approved ☐ Denied
	Application Received	Date	By	Authorized Signature
	Post-Inspection	Date	By	Account Coding 2004-61-445-6169-91151001-0578
	Rebate Check	Check #	Amount	Date Issued

Send Above Portion To:

Pilot Water Softener Rebate Program
Water Use Efficiency Unit
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118-3614

Santa Clara Valley Water District

KEEP THIS PORTION

Appendix D. SCVWD Website Posting

Home : Water : Water conservation : In the home

Santa Clara Valley Water District

Water | Emergency | News | For teachers | Business & permits | About us | Contact us

Search Go!

Water conservation in the home

Water

- High efficiency toilet rebates
- House call request
- Washer rebates
- Demonstration gardens
- Looking for water efficient plants
- Water-wise plant list

Indoor water use accounts for about half of your monthly water bill. Finding ways to use water more wisely in the home can lower water and energy costs.

It's easy to save water with the following resources available to Santa Clara County residents. For more information, you can always call our Water Conservation Hotline at (408) 265-2607, ext. 2554.

Current programs:

Water-Wise House Calls

Are you concerned about high water bills and would like to use less water? Sign up today for a FREE House Call. House Calls are available for Santa Clara County residents. Trained water surveyors will come out to your home or apartment complex and spend at least an hour with you, reviewing your water use, providing low-flow showerheads and aerators (if needed), and suggesting water-wise recommendations - including an annual irrigation schedule for your landscape.

House Calls are available weekdays and Saturdays during daylight hours to suit your schedule. If you are interested, call (800) 548-1882 to schedule an appointment, or click here to submit an online Water-wise House Call request.

If you are a customer of the San Jose Water Company, you will need to call (408) 279-7900 to schedule an appointment.

Related Information

- Rules of Thumb for Water-Wise Gardening (PDF 1.4 MB)
- How is the district planning for future water needs?
- How clean is our water?
- Where does our water come from?
- American Water Works Association conservation information
- H2OUSE - Home water conservation help
- Hot Water Re-circulation Pilot Study report (PDF 793K)

Indoor water use accounts for about half of your monthly water bill. Finding ways to use water more wisely in the home can lower water and energy costs.

It's easy to save water with the following resources available to Santa Clara County residents. For more information, you can always call our Water Conservation Hotline at (408) 265-2607, ext. 2554.

Water Softener Rebate Program

The Water Softener Rebate Program has been extended; the program is targeted to residential water softener owner who are considering replacing their currently working, old, inefficient water softener (purchased before November 1999) with a new demand-initiated regeneration (DIR) water softener.

The new water softener must meet the California efficiency rating of at least 4,000 grains of total hardness removal per pound of salt utilized. The new water softener must be purchased after November 15, 2003 and installation must be in Santa Clara County. Offer expires when funds are depleted. Call the Santa Clara Valley Water District at (408) 265-2607 ext. 2554 for further details or download information and a rebate application.

9. Appendix E. San Jose Water Company Rebate Notice to Customer

SAN JOSE WATER COMPANY

WHEN MAKING INQUIRIES
CONTACT OUR OFFICE AT:

374 West Santa Clara St.
San Jose, CA 95196
(408) 279-7900
OFFICE HOURS: 8:00 AM TO 5:30 PM MONDAY-FRIDAY
www.sjwater.com

BILLING DATE
3/19/2004

[redacted]
ACCOUNT NUMBER
[redacted]
SERVICE ADDRESS
[redacted]

BILLING PERIOD FROM	TO	METER SIZE	SERVICE CHARGE	
1/15/2004	3/15/2004	R02 3/4"	$18.74	H ---

READING	TOTAL CCF (1 CCF = 748 GALLONS)	QUANTITY RATES PER CCF	QUANTITY CHARGE
2105	22	22 X $1.83140	40.29

PUC Surcharge 1.4%		.83
City Utility Users Tax 5%		2.99
Current Charges		62.85
Previous Balance		71.78
Payments Received	1/26/2004	71.78CR
Total Due		62.85

Come on out to our Third Annual Water Awareness Night at the San Jose Giants, May 21. Complimentary tickets are available. Please see the enclosed brochure for details.

Thinking about replacing your old inefficient water softener? The Santa Clara Valley Water District is offering a limited-time rebate of $150.00. Please call (408)265-2607 ext. 2554 for more information.

10. Appendix F. SCVWD Customer Survey Form

Softener rebate survey

Dec. 17, 2004

Dear Customer,

The Santa Clara Valley Water District thanks you for participating in the Pilot Water Softener Rebate Program. To help us measure the environmental benefits of this program and to better design a similar full-scale program in the near future, we would like your feedback.

Please take a few moments to complete the survey form below and return it in the self-addressed, postage-paid envelope provided. Thank you in advance for your time. Your quick response is much appreciated.

Also attached is a fact sheet on the benefits of switching from salt to potassium chloride for regenerating your water softener.

If you have any questions about this program or the survey, contact Linda Liu at **(408) 265-2607, ext. 3165**.

We value your input!

Please help us improve the **Santa Clara Valley Water District's Pilot Water Softener Rebate Program**. Take a moment to complete this survey and return it to the Water District in the enclosed postage-paid envelope. Your input is very important to us.

1. What type of salt do you use for your water-softening unit? *Please check one.*

❒ **sodium chloride** ❒ **potassium chloride**

2. Based on your observations, do you use more or fewer bags of salt for your new water softener? *Please check one.*

❒ More bags of salt used ❒ Fewer bags of salt used

3. Approximately how many bags of salt do you use per month for your water softener?

❒ 1-2 bags ❒ 3-4 bags ❒ 5-6 bags ❒ Other, _____ bags

4. How did you hear about the rebate program?

❒ Insert in my water bill ❒ Place where I bought my water softener
❒ Heard from another customer ❒ Mailing from the Water District
❒ Other, please specify: _____

5. Do you have any suggestions for improving the program and our level of service in the future? Please specify: _____
_____

frequently asked questions

What's the difference between sodium chloride and potassium chloride?

Salt, or sodium chloride, is commonly used in water softeners to remove the hardness from water in homes and businesses. Potassium chloride works exactly the same way that sodium does in the water-softening process. However, there has been a slow but steady growth in the use of potassium chloride (KCl), which is chemically related to salt and has the same water-softening characteristics. Most water softeners remove hardness (calcium and magnesium) and iron from water through an ion-exchange process. The harder the water, the more sodium is added to effect softening.

How does potassium chloride benefit the environment?

Potassium chloride is a naturally occurring mineral, and it is often marketed as an agricultural plant food. Sodium can be harmful to plants, whereas potassium is an essential mineral for plant growth. By switching from sodium chloride to potassium chloride, it will reduce sodium and chloride being discharged into municipal wastewater treatment facilities, thus enhancing the quality of recycled water and soil conditions.

Changing regenerants

If you switch from using salt to potassium chloride, you may just add the potassium chloride pellets into the tank where salts are added. No equipment changes or adjustments are required for most household water softeners; however, please refer to your owner's manual or contact manufactures for compatibility.

How does potassium affect your health?

Please consult your physician if you have any questions related to the health issue on consumption of potassium chloride-treated soft water.

contact

For more information about potassium chloride, contact Associate Engineer Ray Wong at **(408) 265-2607**, **ext. 2288**, or Linda Liu at **ext. 3165**.

WATER – OUR MISSION FOR 75 YEARS
Santa Clara Valley Water District

11. Appendix G. Data Formatting

```
-------------------------------------------------------------------------------------------------
      log:  C:\Project\SCV -Water Softner Rebate Program\data\SCV_data_v1.log
  log type:  text
 opened on:   7 May 2005, 18:28:10

. **AUTHOR:       SANJAY GAUR
> **NOTE:
> INPUT:  water_consumption_data_consultants_final_ 8apr2005.dta
> OUTPUT:         SCV_data.dta;
. use "water_consumption_data_consultants_final_ 8apr2005.dta", clear;

. des;

Contains data from water_consumption_data_consultants_final_ 8apr2005.dta
  obs:          483
 vars:          159
 size:      625,968 (99.6% of memory free)
-------------------------------------------------------------------------------
              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
count           double %9.0g
account         str16  %16s
zip             str14  %14s
housing         double %10.0g
retailer        str42  %42s
installa        long   %d                     installation
units           str12  %12s
meter1          long   %d
read1           double %11.0g
consump1        double %15.0g
ae1             str16  %16s
meter2          long   %d
read2           double %11.0g
consump2        double %14.0g
ae2             str10  %10s
meter3          long   %d
read3           double %10.0g
consump3        double %11.0g
ae3             str10  %10s
meter4          long   %d
read4           double %10.0g
consump4        double %13.0g
ae4             str12  %12s
meter5          long   %d
read5           double %10.0g
consump5        double %10.0g
ae5             str10  %10s
meter6          long   %d
read6           double %10.0g
consump6        double %10.0g
ae6             str10  %10s
meter7          long   %d
read7           double %10.0g
consump7        double %10.0g
ae7             str10  %10s
meter8          long   %d
read8           double %10.0g
consump8        double %13.0g
ae8             str10  %10s
meter9          long   %d
read9           double %10.0g
consump9        double %9.0g
ae9             str12  %12s
meter10         long   %d
read10          double %11.0g
consum10        double %9.0g                   consump10
ae10            str10  %10s
meter11         long   %d
read11          double %10.0g
consum11        double %9.0g                   consump11
ae11            str10  %10s
meter12         long   %d
read12          double %10.0g
consum12        double %9.0g                   consump12
ae12            str10  %10s
meter13         long   %d
read13          double %15.0g
```

```
consum13      double %15.0g              consump13
ae13          str8   %8s
meter14        long   %d
read14        double %9.0g
consum14      double %13.0g              consump14
ae14          str14  %14s
meter15        long   %d
read15        double %9.0g
consum15      double %9.0g               consump15
ae15          str10  %10s
meter16        long   %d
read16        double %9.0g
consum16      double %9.0g               consump16
ae16          str10  %10s
meter17        long   %d
read17        double %11.0g
consum17      double %11.0g              consump17
ae17          str12  %12s
meter18        long   %d
read18        str14  %14s
consum18      double %9.0g               consump18
ae18          str10  %10s
meter19        long   %d
read19        double %9.0g
consum19      double %9.0g               consump19
ae19          str10  %10s
meter20        long   %d
read20        double %11.0g
consum20      double %9.0g               consump20
ae20          str10  %10s
meter21        long   %d
read21        double %11.0g
consum21      double %9.0g               consump21
ae21          str10  %10s
meter22        long   %d
read22        double %9.0g
consum22      double %9.0g               consump22
ae22          str10  %10s
meter23        long   %d
read23        double %9.0g
consum23      double %9.0g               consump23
ae23          str10  %10s
meter24        long   %d
read24        double %9.0g
consum24      double %9.0g               consump24
ae24          str12  %12s
meter25        long   %d
read25        double %11.0g
consum25      double %9.0g               consump25
ae25          str12  %12s
meter26        long   %d
read26        double %9.0g
consum26      double %9.0g               consump26
ae26          str12  %12s
meter27        long   %d
read27        double %9.0g
consum27      double %9.0g               consump27
ae27          str10  %10s
meter28        long   %d
read28        double %9.0g
consum28      double %9.0g               consump28
ae28          str10  %10s
meter29        long   %d
read29        double %9.0g
consum29      double %9.0g               consump29
ae29          str12  %12s
meter30        long   %d
read30        double %14.0g
consum30      double %12.0g              consump30
ae30          str10  %10s
meter31        long   %d
read31        double %9.0g
consum31      double %9.0g               consump31
ae31          str12  %12s
meter32        long   %d
read32        double %9.0g
consum32      double %9.0g               consump32
ae32          str12  %12s
meter33        long   %d
read33        double %9.0g
consum33      double %9.0g               consump33
ae33          str12  %12s
meter34        long   %d
read34        double %9.0g
```

```
consum34        double %9.0g                  consump34
ae34            str12  %12s
meter35         long   %d
read35          double %10.0g
consum35        double %9.0g                  consump35
ae35            str12  %12s
meter36         long   %d
read36          double %9.0g
consum36        double %9.0g                  consump36
ae36            str12  %12s
meter37         long   %d
read37          double %9.0g
consum37        double %9.0g                  consump37
ae37            str12  %12s
meter38         long   %d
read38          str10  %10s
consum38        str10  %10s                   consump38
ae38            str12  %12s
-------------------------------------------------------------------------------
Sorted by:

. sum;

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
       count |       367         184     106.088          1        367
     account |         0
         zip |         0
     housing |       367           1           0          1          1
    retailer |         0
-------------+--------------------------------------------------------
    installa |       367    16208.04    96.58876      15837      17364
       units |         0
      meter1 |       367    15374.65    1919.454     -21129      16302
       read1 |       367     24670.5    222262.5          5    2624000
    consump1 |       367    100.0463    827.5251          0      12000
-------------+--------------------------------------------------------
         ae1 |         0
      meter2 |       367    15530.05    183.2228      15372      16335
       read2 |       367    24932.84    222859.4          4    2628000
    consump2 |       367    100.6403    699.3446          2       9000
         ae2 |         0
-------------+--------------------------------------------------------
      meter3 |       367    15491.17    1921.879     -21034      16682
       read3 |       367    24873.76    223518.4         38    2635000
    consump3 |       367    114.6676    709.6297          2       9000
         ae3 |         0
      meter4 |       365    15559.54     1487.98     -12591      16413
-------------+--------------------------------------------------------
       read4 |       365    25232.89    226082.3         24    2655000
    consump4 |       365    256.9644    2129.686          2      29000
         ae4 |         0
      meter5 |       363    15691.91    170.1315      15461      16455
       read5 |       363     25628.3    228945.6         19    2676000
-------------+--------------------------------------------------------
    consump5 |       363     272.011    2385.914          2      33000
         ae5 |         0
      meter6 |       357    15737.36      144.82      15492      16450
       read6 |       357    26347.63    233070.8         14    2711000
    consump6 |       357    319.3922     2852.63          1      35000
-------------+--------------------------------------------------------
         ae6 |         0
      meter7 |       356    15786.61    143.9337      15377      16443
       read7 |       356    26712.26    236856.2         25    2747000
    consump7 |       356    334.7135    2987.956          1      36000
         ae7 |         0
-------------+--------------------------------------------------------
      meter8 |       355     15839.8    139.5541      15553      16428
       read8 |       355    27084.99    239843.5         14    2781000
    consump8 |       355     312.569    2774.474          1      34000
         ae8 |         0
      meter9 |       350    15891.32    140.9965      15584      16461
-------------+--------------------------------------------------------
       read9 |       351    27647.95    243707.3         17    2809000
    consump9 |       351    310.1795    2596.791          1      31000
         ae9 |         0
     meter10 |       345    15932.61    135.3203      14940      16412
      read10 |       344    28480.43    248840.7         16    2839000
-------------+--------------------------------------------------------
    consum10 |       345    296.7565    2514.861          3      30000
        ae10 |         0
     meter11 |       343    15990.91    127.5706      15645      16412
      read11 |       343    28762.95    250753.7         75    2852000
    consum11 |       343    202.2507    1730.832          1      26000
```

```
-------------+--------------------------------------------------------
     ae11 |        0
   meter12 |      342    16046.64    133.8094      15675      16371
    read12 |      342     29086.5    252811.7         12    2864000
  consum12 |      341    212.7331    1801.108          2      23000
     ae12 |        0
-------------+--------------------------------------------------------
   meter13 |      342     15993.1    1963.984     -20121      16384
    read13 |      342    29180.37    253792.5         23    2869000
  consum13 |      342    130.7193    1005.116          3      12000
     ae13 |        0
   meter14 |      340    16154.39    155.8691      15354      16450
-------------+--------------------------------------------------------
    read14 |      340    29456.51    255437.9          8    2879000
  consum14 |      340    162.6647    1191.897          3      13000
     ae14 |        0
   meter15 |      335    16210.27    164.9342      15769      16450
    read15 |      335    30009.26    258281.9         39    2886000
-------------+--------------------------------------------------------
  consum15 |      335    149.5015    1104.407          4      16000
     ae15 |        0
   meter16 |      332    16265.18    178.0948      15561      16478
    read16 |      332     30395.9    260375.2          6    2892000
  consum16 |      332    142.9277    1130.312          2      17000
-------------+--------------------------------------------------------
     ae16 |        0
   meter17 |      299    16308.18    188.0032      15826      16714
    read17 |      299    33652.07    276189.9         15    2905000
  consum17 |      299    256.1873    2066.649          1      27000
     ae17 |        0
-------------+--------------------------------------------------------
   meter18 |      176    16271.82    212.8061      15858      16461
    read18 |        0
  consum18 |      176    633.2955    4017.521          1      31000
     ae18 |        0
   meter19 |       89    16179.71    244.8646      15888      16485
-------------+--------------------------------------------------------
    read19 |       89    110396.5    512487.2         53    2965000
  consum19 |       89    1468.371    6795.016          0      37000
     ae19 |        0
   meter20 |       57    16062.67     176.003      15918      16498
    read20 |       57    173317.7    641266.9        143    2997000
-------------+--------------------------------------------------------
  consum20 |       57    1930.421     7122.17          2      32000
     ae20 |        0
   meter21 |       51    3153.196    92066.95    -641444      16275
    read21 |       51      195359    682619.2        163    3025000
  consum21 |       51    1982.745    7010.763          2      33000
-------------+--------------------------------------------------------
     ae21 |        0
   meter22 |       51    16074.73    98.57486      15980      16304
    read22 |       51    197419.4    689574.6        183    3054000
  consum22 |       51    2060.373    7246.421          2      34000
     ae22 |        0
-------------+--------------------------------------------------------
   meter23 |       51    16104.24    99.70428      16012      16339
    read23 |       51    198536.1    693325.2        191    3061000
  consum23 |       51    1116.627     4248.39          2      23000
     ae23 |        0
   meter24 |       51    16135.75    99.48444      16042      16367
-------------+--------------------------------------------------------
    read24 |       51      199201      695304        196    3065000
  consum24 |       51    664.9216    2736.721          2      16000
     ae24 |        0
   meter25 |       51    16167.69    98.01153      16077      16398
    read25 |       51    199844.7    697338.4        205    3069000
-------------+--------------------------------------------------------
  consum25 |       51    644.4118    2603.259          3      14000
     ae25 |        0
   meter26 |       50    16193.14    94.49328      16105      16343
    read26 |       50    204281.1    705455.2        211    3071000
  consum26 |       50      517.12    2117.274          3      12000
-------------+--------------------------------------------------------
     ae26 |        0
   meter27 |       50    16244.08    199.1683      16134      17467
    read27 |       50    205464.4      709218         38    3077000
  consum27 |       50     1196.72     4312.81          2      19000
     ae27 |        0
-------------+--------------------------------------------------------
   meter28 |       50    16253.06    93.34431      16162      16404
    read28 |       50    207388.2    715688.1         51    3097000
  consum28 |       50     1937.74    6758.652          1      33000
     ae28 |        0
   meter29 |       50    16283.22    94.38616      16196      16434
```

```
-------------+---------------------------------------------------------
     read29 |        50    209431.6    722683.5         10    3122000
    consum29 |        50     2096.38    7128.958          2      28000
       ae29 |         0
     meter30 |        36    16259.64    45.96841      16226      16415
     read30 |        36    292610.2    848902.9         34    3143000
-------------+---------------------------------------------------------
    consum30 |        36    2852.278    8178.614          5      29000
       ae30 |         0
     meter31 |        34    16281.09    26.68034      16253      16390
     read31 |        34    313131.1    880591.9         58    3170000
    consum31 |        34    3463.882    9703.291          7      37000
-------------+---------------------------------------------------------
       ae31 |         0
     meter32 |        34    16312.41    26.89837      16286      16421
     read32 |        34    316299.4    889100.4         75    3196000
    consum32 |        34    3168.382    8807.212          8      30000
       ae32 |         0
-------------+---------------------------------------------------------
     meter33 |        34    16342.53    27.42951      16316      16455
     read33 |        34    319641.7      898369        101    3223000
    consum33 |        34    3343.324    9446.777          9      38000
       ae33 |         0
     meter34 |        32    16367.25    9.290995      16348      16393
-------------+---------------------------------------------------------
     read34 |        32    341940.7    929843.5        125    3240000
    consum34 |        32    2452.813    6931.671          4      30000
       ae34 |         0
     meter35 |        32    16396.44    9.611611      16377      16419
     read35 |        32    342949.1    932548.4        129    3244000
-------------+---------------------------------------------------------
    consum35 |        32    1008.625    3480.125          3      18000
       ae35 |         0
     meter36 |        22    16423.86    6.861178      16408      16435
     read36 |        22    2698.636    1465.014        134       4747
    consum36 |        22    8.681818    4.167749          2         17
-------------+---------------------------------------------------------
       ae36 |         0
     meter37 |         4       16269    213.2807      16074      16460
     read37 |         4     3007.25    830.7283       2149       4143
    consum37 |         4           8     2.44949          5         10
       ae37 |         0
-------------+---------------------------------------------------------
     meter38 |         0
     read38 |         0
    consum38 |         0
       ae38 |         0

. drop if count==.;
(116 observations deleted)

. gen zip_r = real(substr(zip,1,5));

. l zip_r zip in 1/40;

     +----------------+
     | zip_r      zip |
     |----------------|
  1. | 95014    95014 |
  2. | 94024   94024- |
  3. | 94024   94024- |
  4. | 94024   94024- |
  5. | 94024    94024 |
     |----------------|
  6. | 94022    94022 |
  7. | 94024    94024 |
  8. | 94024    94024 |
  9. | 94022    94022 |
 10. | 95014    95014 |
     |----------------|
 11. | 94024    94024 |
 12. | 94024    94024 |
 13. | 95014    95014 |
 14. | 94024    94024 |
 15. | 94024    94024 |
     |----------------|
 16. | 94024    94024 |
 17. | 94024    94024 |
 18. | 94024    94024 |
 19. | 95020    95020 |
 20. | 95020    95020 |
     |----------------|
 21. | 95020    95020 |
 22. | 95020    95020 |
```

```
 23. | 95119    95119 |
 24. | 95123    95123 |
 25. | 95111   95111- |
     |----------------|
 26. | 95119    95119 |
 27. | 95123    95123 |
 28. | 95111   95111- |
 29. | 95111   95111- |
 30. | 95123    95123 |
     |----------------|
 31. | 95119    95119 |
 32. | 95123    95123 |
 33. | 95119    95119 |
 34. | 95111   95111- |
 35. | 95123    95123 |
     |----------------|
 36. | 95138    95138 |
 37. | 95139   95139- |
 38. | 95136    95136 |
 39. | 95123    95123 |
 40. | 95138   95138- |
     +----------------+

. drop zip;

. rename zip_r zip;

. label var housing "1 - SF";

. rename  installa instal;

. label var instal "Date of Purchase";

. tab units;

       units |      Freq.     Percent        Cum.
-------------+-----------------------------------
         CCF |       334       91.01       91.01
     Gallons |         4        1.09       92.10
         HCF |        29        7.90      100.00
-------------+-----------------------------------
       Total |       367      100.00

. *some read are string, need to convert to numeric;
. des read*;

              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
read1           double %11.0g
read2           double %11.0g
read3           double %10.0g
read4           double %10.0g
read5           double %10.0g
read6           double %10.0g
read7           double %10.0g
read8           double %10.0g
read9           double %10.0g
read10          double %11.0g
read11          double %10.0g
read12          double %10.0g
read13          double %15.0g
read14          double %9.0g
read15          double %9.0g
read16          double %9.0g
read17          double %11.0g
read18          str14  %14s
read19          double %9.0g
read20          double %11.0g
read21          double %11.0g
read22          double %9.0g
read23          double %9.0g
read24          double %9.0g
read25          double %11.0g
read26          double %9.0g
read27          double %9.0g
read28          double %9.0g
read29          double %9.0g
read30          double %14.0g
read31          double %9.0g
read32          double %9.0g
read33          double %9.0g
read34          double %9.0g
read35          double %10.0g
```

```
read36          double %9.0g
read37          double %9.0g
read38          str10  %10s

. gen rd18= real(read18);
(191 missing values generated)

. drop read18;

. rename rd18 read18;

. gen rd38= real(read38);
(367 missing values generated)

. drop read38;

. rename rd38 read38;

. rename consump1  consum1;

. rename consump2  consum2;

. rename consump3  consum3;

. rename consump4  consum4;

. rename consump5  consum5;

. rename consump6  consum6;

. rename consump7  consum7;

. rename consump8  consum8;

. rename consump9  consum9;

. des consum*;

              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
consum1         double %15.0g
consum2         double %14.0g
consum3         double %11.0g
consum4         double %13.0g
consum5         double %10.0g
consum6         double %10.0g
consum7         double %10.0g
consum8         double %13.0g
consum9         double %9.0g
consum10        double %9.0g                consump10
consum11        double %9.0g                consump11
consum12        double %9.0g                consump12
consum13        double %15.0g               consump13
consum14        double %13.0g               consump14
consum15        double %9.0g                consump15
consum16        double %9.0g                consump16
consum17        double %11.0g               consump17
consum18        double %9.0g                consump18
consum19        double %9.0g                consump19
consum20        double %9.0g                consump20
consum21        double %9.0g                consump21
consum22        double %9.0g                consump22
consum23        double %9.0g                consump23
consum24        double %9.0g                consump24
consum25        double %9.0g                consump25
consum26        double %9.0g                consump26
consum27        double %9.0g                consump27
consum28        double %9.0g                consump28
consum29        double %9.0g                consump29
consum30        double %12.0g               consump30
consum31        double %9.0g                consump31
consum32        double %9.0g                consump32
consum33        double %9.0g                consump33
consum34        double %9.0g                consump34
consum35        double %9.0g                consump35
consum36        double %9.0g                consump36
consum37        double %9.0g                consump37
consum38        str10  %10s                 consump38

. gen cn38= real(consum38);
(367 missing values generated)

. drop consum38;
```

```
. rename cn38 consum38;

. reshape long meter read consum ae, i(count) j(interval);
(note: j = 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
>  33 34 35 36 37 38)

Data                               wide   ->   long
-----------------------------------------------------------------------------
Number of obs.                     367   ->   13946
Number of variables                159   ->      12
j variable (38 values)                   ->   interval
xij variables:
             meter1 meter2 ... meter38   ->   meter
               read1 read2 ... read38   ->   read
           consum1 consum2 ... consum38   ->   consum
                     ae1 ae2 ... ae38   ->   ae
-----------------------------------------------------------------------------

. label var interval "Counts btw reads";

. tab ae;

             ae |      Freq.     Percent        Cum.
------------------+-----------------------------------
            (A) |          1        0.01        0.01
              A |      6,955       99.97       99.99
              E |          1        0.01      100.00
------------------+-----------------------------------
          Total |      6,957      100.00

. replace ae="A" if ae=="(A)";
(1 real change made)

. tab ae;

             ae |      Freq.     Percent        Cum.
------------------+-----------------------------------
              A |      6,956       99.99       99.99
              E |          1        0.01      100.00
------------------+-----------------------------------
          Total |      6,957      100.00

.  rename meter date;

. rename instal install_date;

. **INstall date is an issue:
> *assume will take 30 days to install water softner;
. gen install=1 if install_date+30<date;
(5453 missing values generated)

. replace install=0 if install==.;
(5453 real changes made)

. label var install "0-no install, 1-install";

. count;
13946

. drop if consum==.;
(7016 observations deleted)

. tab  retailer if date==.;

                              retailer |      Freq.     Percent        Cum.
-------------------------------------------+-----------------------------------
                 San Jose Water Company |          1      100.00      100.00
-------------------------------------------+-----------------------------------
                                   Total |          1      100.00

. drop if date==.;
(1 observation deleted)

. count;
 6929

. tab install;

       0-no |
   install, |
  1-install |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |      5,452       78.68       78.68
```

```
          1 |      1,477       21.32      100.00
------------+-----------------------------------
      Total |      6,929      100.00

. gen month=month(date);

. gen year=year(date);

. tab year;

       year |      Freq.     Percent        Cum.
------------+-----------------------------------
        203 |          1        0.01        0.01
       1902 |          2        0.03        0.04
       1904 |          1        0.01        0.06
       1925 |          1        0.01        0.07
       2000 |          1        0.01        0.09
       2002 |      1,917       27.67       27.75
       2003 |      2,391       34.51       62.26
       2004 |      2,470       35.65       97.91
       2005 |        144        2.08       99.99
       2007 |          1        0.01      100.00
------------+-----------------------------------
      Total |      6,929      100.00

. tab month year;

           |                                  year
     month |       203      1902      1904      1925      2000      2002 |     Total
-----------+--------------------------------------------------------------+----------
         1 |         0         0         0         0         0        86 |       637
         2 |         0         1         0         0         0        93 |       472
         3 |         0         0         0         0         0        89 |       541
         4 |         0         0         0         0         0       161 |       541
         5 |         0         1         0         0         0       197 |       650
         6 |         0         0         0         0         0       169 |       555
         7 |         0         0         0         1         0       191 |       650
         8 |         0         0         0         0         0       179 |       559
         9 |         0         0         0         0         0       198 |       618
        10 |         1         0         0         0         0       185 |       578
        11 |         0         0         1         0         1       195 |       579
        12 |         0         0         0         0         0       174 |       549
-----------+--------------------------------------------------------------+----------
     Total |         1         2         1         1         1     1,917 |     6,929


           |                        year
     month |      2003      2004      2005      2007 |     Total
-----------+--------------------------------------+----------
         1 |       212       221       118         0 |       637
         2 |       175       184        19         0 |       472
         3 |       213       234         5         0 |       541
         4 |       188       192         0         0 |       541
         5 |       226       226         0         0 |       650
         6 |       180       206         0         0 |       555
         7 |       224       234         0         0 |       650
         8 |       200       180         0         0 |       559
         9 |       200       219         1         0 |       618
        10 |       203       187         1         1 |       578
        11 |       176       206         0         0 |       579
        12 |       194       181         0         0 |       549
-----------+--------------------------------------+----------
     Total |     2,391     2,470       144         1 |     6,929


. drop if year < 2000 | year > 2005;
(6 observations deleted)

. tab month year;

           |                          year
     month |      2000      2002      2003      2004      2005 |     Total
-----------+-------------------------------------------------+----------
         1 |         0        86       212       221       118 |       637
         2 |         0        93       175       184        19 |       471
         3 |         0        89       213       234         5 |       541
         4 |         0       161       188       192         0 |       541
         5 |         0       197       226       226         0 |       649
         6 |         0       169       180       206         0 |       555
         7 |         0       191       224       234         0 |       649
         8 |         0       179       200       180         0 |       559
         9 |         0       198       200       219         1 |       618
        10 |         0       185       203       187         1 |       576
        11 |         1       195       176       206         0 |       578
```

```
        12 |        0       174       194       181         0 |       549
-----------+--------------------------------------------------+----------
     Total |        1     1,917     2,391     2,470       144 |     6,923


. sort count date;

. label data "Santa Clara Water Softner";

. des;

Contains data
  obs:         6,923                          Santa Clara Water Softner
 vars:            15
 size:     1,017,681 (99.4% of memory free)
-------------------------------------------------------------------------------
              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
count           double %9.0g
interval        byte   %9.0g                 Counts btw reads
account         str16  %16s
housing         double %10.0g                1 - SF
retailer        str42  %42s
install_date    long   %d                    Date of Purchase
units           str12  %12s
date            long   %d
ae              str16  %16s
zip             float  %9.0g
read            double %9.0g
consum          double %9.0g
install         float  %9.0g                 0-no install, 1-install
month           float  %9.0g
year            float  %9.0g
-------------------------------------------------------------------------------
Sorted by:  count  date
     Note:  dataset has changed since last saved

. sum;

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
       count |      6923     182.237    115.5019          1        367
    interval |      6923    11.09765    7.503346          1         37
     account |         0
     housing |      6923           1           0          1          1
    retailer |         0
-------------+--------------------------------------------------------
install_date |      6923    16205.05    96.40964      15837      17364
       units |         0
        date |      6923    15930.75    307.8576      14940      16714
          ae |         0
         zip |      6923    94988.98    321.6691      94022      95148
-------------+--------------------------------------------------------
        read |      6922    50576.29    345031.7          4    3244000
      consum |      6923    404.7163    2947.473          0      38000
     install |      6923    .2132024     .409599          0          1
       month |      6923    6.532428    3.422006          1         12
        year |      6923    2003.121    .8388297       2000       2005

. save SCV_data_v1, replace;
file SCV_data_v1.dta saved

. log close;
      log:  C:\Project\SCV -Water Softner Rebate Program\data\SCV_data_v1.log
  log type:  text
 closed on:   7 May 2005, 18:28:16
----------------------------------------------------------------------------------------------------
```

12. Appendix H. Savings Estimate

```
-------------------------------------------------------------------------------------------------
      log:  C:\Project\SCV -Water Softner Rebate Program\data\SCV_analysis10.log
  log type:  text
 opened on:   1 Jun 2005, 21:37:04

. **AUTHOR:       SANJAY GAUR
> **NOTE:         computes saving from water softner program
> INPUT:  SCV_data_v1.dta
> OUTPUT:         None;
. use SCV_data_v1, clear;
(Santa Clara Water Softner)

. des;

Contains data from SCV_data_v1.dta
  obs:         6,923                          Santa Clara Water Softner
 vars:            15                          7 May 2005 18:28
 size:     1,017,681 (99.4% of memory free)
-------------------------------------------------------------------------------
              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
count           double %9.0g
interval        byte   %9.0g                 Counts btw reads
account         str16  %16s
housing         double %10.0g                1 - SF
retailer        str42  %42s
install_date    long   %d                    Date of Purchase
units           str12  %12s
date            long   %d
ae              str16  %16s
zip             float  %9.0g
read            double %9.0g
consum          double %9.0g
install         float  %9.0g                 0-no install, 1-install
month           float  %9.0g
year            float  %9.0g
-------------------------------------------------------------------------------
Sorted by:  count  date

. sum;

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
       count |      6923     182.237    115.5019          1        367
    interval |      6923    11.09765    7.503346          1         37
     account |         0
     housing |      6923           1           0          1          1
    retailer |         0
-------------+--------------------------------------------------------
install_date |      6923    16205.05    96.40964      15837      17364
       units |         0
        date |      6923    15930.75    307.8576      14940      16714
          ae |         0
         zip |      6923    94988.98    321.6691      94022      95148
-------------+--------------------------------------------------------
        read |      6922    50576.29    345031.7          4    3244000
      consum |      6923    404.7163    2947.473          0      38000
     install |      6923    .2132024     .409599          0          1
       month |      6923    6.532428    3.422006          1         12
        year |      6923    2003.121    .8388297       2000       2005

. *basic info on data;
. count;
 6923

. sort count;

. count if count~=count[_n-1];
  367

. *number of observation per month and year;
. tab month year;

           |                      year
     month |      2000       2002       2003       2004       2005 |     Total
-----------+-------------------------------------------------------+----------
         1 |         0         86        212        221        118 |       637
```

```
     2 |       0       93      175      184       19 |      471
     3 |       0       89      213      234        5 |      541
     4 |       0      161      188      192        0 |      541
     5 |       0      197      226      226        0 |      649
     6 |       0      169      180      206        0 |      555
     7 |       0      191      224      234        0 |      649
     8 |       0      179      200      180        0 |      559
     9 |       0      198      200      219        1 |      618
    10 |       0      185      203      187        1 |      576
    11 |       1      195      176      206        0 |      578
    12 |       0      174      194      181        0 |      549
-----------+-----------------------------------------------------------+----------
     Total |       1    1,917    2,391    2,470      144 |    6,923

. *number of observation before and after installation;
. tab install ;

      0-no |
   install, |
  1-install |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |      5,447       78.68       78.68
          1 |      1,476       21.32      100.00
------------+-----------------------------------
      Total |      6,923      100.00

. *Distribution of retail water agency;
. tab retailer;

                                  retailer |      Freq.     Percent        Cum.
-------------------------------------------+-----------------------------------
      California Water Services Company |        543        7.84        7.84
   Gilroy Community Services Department |        140        2.02        9.87
                Great Oaks Water Company |        645        9.32       19.18
                    Morgan Hill, City of |        302        4.36       23.54
       San Jose Municipal Water System |        108        1.56       25.10
                 San Jose Water Company |      4,167       60.19       85.30
  Santa Clara Water Department, City of |        762       11.01       96.30
Sunnyvale Public Works Department, City |        256        3.70      100.00
-------------------------------------------+-----------------------------------
                                    Total |      6,923      100.00

. sort count date;

. *generating the number of reads btw dates;
. gen meter_rd = date-date[_n-1] if count==count[_n-1];
(367 missing values generated)

. *distribution of reads, note we have three cluster, 30 days, 60 days and 120 days;
. tab meter_rd;

   meter_rd |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |         30        0.46        0.46
          1 |          7        0.11        0.56
          2 |          4        0.06        0.63
          3 |          6        0.09        0.72
         11 |          2        0.03        0.75
         14 |          2        0.03        0.78
         19 |          1        0.02        0.79
         20 |          1        0.02        0.81
         21 |          1        0.02        0.82
         22 |          2        0.03        0.85
         23 |          3        0.05        0.90
         24 |         15        0.23        1.13
         25 |         21        0.32        1.45
         26 |         21        0.32        1.77
         27 |         80        1.22        2.99
         28 |        210        3.20        6.19
         29 |        277        4.23       10.42
         30 |        310        4.73       15.15
         31 |        233        3.55       18.70
         32 |        173        2.64       21.34
         33 |        152        2.32       23.66
         34 |         96        1.46       25.12
         35 |         42        0.64       25.76
         36 |         20        0.31       26.07
         37 |          3        0.05       26.11
         38 |          6        0.09       26.21
         39 |          1        0.02       26.22
         40 |          1        0.02       26.24
         41 |          1        0.02       26.25
         42 |          3        0.05       26.30
```

```
        43 |        1       0.02      26.31
        45 |        2       0.03      26.34
        47 |        2       0.03      26.37
        48 |        1       0.02      26.39
        49 |        1       0.02      26.40
        52 |        4       0.06      26.46
        53 |        3       0.05      26.51
        54 |        5       0.08      26.59
        55 |       28       0.43      27.01
        56 |      279       4.26      31.27
        57 |      475       7.25      38.51
        58 |      433       6.60      45.12
        59 |      422       6.44      51.56
        60 |      399       6.09      57.64
        61 |      544       8.30      65.94
        62 |      743      11.33      77.27
        63 |      714      10.89      88.16
        64 |      232       3.54      91.70
        65 |      105       1.60      93.30
        66 |       88       1.34      94.65
        67 |       86       1.31      95.96
        68 |       78       1.19      97.15
        69 |       93       1.42      98.57
        70 |       33       0.50      99.07
        71 |        6       0.09      99.16
        72 |        1       0.02      99.18
        75 |        1       0.02      99.19
        76 |        1       0.02      99.21
        77 |        2       0.03      99.24
        92 |        1       0.02      99.25
        95 |        1       0.02      99.27
        98 |        1       0.02      99.28
       117 |        1       0.02      99.30
       118 |        1       0.02      99.31
       119 |        4       0.06      99.37
       120 |        5       0.08      99.45
       121 |        4       0.06      99.51
       122 |        4       0.06      99.57
       123 |       10       0.15      99.73
       124 |        5       0.08      99.80
       125 |        2       0.03      99.83
       126 |        2       0.03      99.86
       127 |        1       0.02      99.88
       128 |        1       0.02      99.89
       130 |        1       0.02      99.91
       151 |        1       0.02      99.92
       179 |        1       0.02      99.94
       187 |        1       0.02      99.95
       239 |        1       0.02      99.97
       301 |        1       0.02      99.98
       544 |        1       0.02     100.00
------------+-----------------------------------
     Total |    6,556     100.00

. *consumption based in CCF only;
. gen cn = consum if units=="CCF" | units=="HCF";
(140 missing values generated)

. *converting Gallons into CCF;
. replace cn = consum/748 if units=="Gallons";
(140 real changes made)

. gen day= day(date);

. *CCF consumption per day;
. gen con = cn/meter_rd;
(397 missing values generated)

. *keeping data set for Dec in 2003 and 2004;
. keep if month==12;
(6374 observations deleted)

. keep if year==2003 | year==2004;
(174 observations deleted)

. *droping observation where installation of water softner happened before Dec 2003;
. drop if install==1 & year==2003;
(2 observations deleted)

. *all partipants are SF;
. tab housing;

     1 - SF |      Freq.     Percent        Cum.
------------+-----------------------------------
```

```
          1 |       373      100.00      100.00
------------+-----------------------------------
      Total |       373      100.00

. *we should have two observation per account, one before and another after installation;
. by count: egen x = sum(housing);

. *for some reason we have 1 and 3, due to poor data;
. tab x;

          x |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |        25        6.70        6.70
          2 |       336       90.08       96.78
          3 |        12        3.22      100.00
------------+-----------------------------------
      Total |       373      100.00

. keep if x==2;
(37 observations deleted)

. *code for pre install;
. gen pre_install = 1 if install[_n+1]==1;
(172 missing values generated)

. count;
  336

. sort month year;

. by month year: egen pre_con = mean(con) if pre_install==1;
(172 missing values generated)

. by month year: egen cur_con = mean(con) if install==1;
(172 missing values generated)

. sum pre_con cur_con ;

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
     pre_con |       164    .4293059           0   .4293059   .4293059
     cur_con |       164    .3525831           0   .3525831   .3525831

. log close;
       log:  C:\Project\SCV -Water Softner Rebate Program\data\SCV_analysis10.log
  log type:  text
 closed on:   1 Jun 2005, 21:37:05
```

13. Appendix I. Missing Data Observations

Retail Water Agency	Year	Month
California Water Services Company	2003	11
California Water Services Company	2003	11
California Water Services Company	2003	10
California Water Services Company	2003	11
Morgan Hill, City of	2003	10
Morgan Hill, City of	2003	9
Morgan Hill, City of	2003	11
Morgan Hill, City of	2003	11
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2004	1
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2003	6
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2004	10
San Jose Municipal Water System	2003	9
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2003	8
San Jose Municipal Water System	2003	6
San Jose Municipal Water System	2003	4
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2003	6
San Jose Municipal Water System	2003	8
San Jose Municipal Water System	2003	9
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2003	10
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2003	6
San Jose Municipal Water System	2003	9
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2003	11
San Jose Municipal Water System	2003	11
Sunnyvale Public Works Department, City	2003	11
Sunnyvale Public Works Department, City	2003	11
Sunnyvale Public Works Department, City	2003	7
Sunnyvale Public Works Department, City	2003	11
Sunnyvale Public Works Department, City	2003	7
Sunnyvale Public Works Department,	2003	9

14. Appendix J. Calculations of Water Cost Savings to Customers

San Jose Water Company water rate to customer per CCF = $1.9901
Equipment efficiency discount of 2.5% begins in the 4th year after the water softener is placed in operation
Escalation rate of 1.5% applied to the cost of water over 20 years
Discount rate of 4.0% applied to the cost of water over 20 years

Year	Water Savings (gal)	Water savings per customer (gal/yr)	Water savings per customer (CCF/yr)	Escalated water rate ($/CCF)	Undiscounted total water savings for 400 customers ($/yr)	Discounted total water savings for 400 customers ($/yr)	Undiscounted Costs ($)	Discounted Costs ($)
1	1,588,800.00	3,972	5.31	$1.99	$4,226.82	$4,064.25	$228,218.00	$219,440.38
2	1,588,800.00	3,972	5.31	$2.02	$4,290.22	$4,125.21		
3	1,588,800.00	3,972	5.31	$2.05	$4,354.57	$4,187.09		
4	**1,549,080.00**	**3,873**	**5.18**	**$2.08**	**$4,309.39**	**$4,143.65**		
5	1,510,353.00	3,776	5.05	$2.11	$4,264.68	$4,100.66		
6	1,472,594.18	3,681	4.92	$2.14	$4,220.44	$4,058.11		
7	1,435,779.32	3,589	4.80	$2.18	$4,176.65	$4,016.01		
8	1,399,884.84	3,500	4.68	$2.21	$4,133.32	$3,974.34		
9	1,364,887.72	3,412	4.56	$2.24	$4,090.44	$3,933.11		
10	1,330,765.52	3,327	4.45	$2.28	$4,048.00	$3,892.30		
11	1,297,496.39	3,244	4.34	$2.31	$4,006.00	$3,851.92		
12	1,265,058.98	3,163	4.23	$2.34	$3,964.44	$3,811.96		
13	1,233,432.50	3,084	4.12	$2.38	$3,923.31	$3,772.41		
14	1,202,596.69	3,006	4.02	$2.42	$3,882.60	$3,733.27		
15	1,172,531.77	2,931	3.92	$2.45	$3,842.32	$3,694.54		
16	1,143,218.48	2,858	3.82	$2.49	$3,802.46	$3,656.21		
17	1,114,638.02	2,787	3.73	$2.53	$3,763.01	$3,618.27		
18	1,086,772.07	2,717	3.63	$2.56	$3,723.96	$3,580.73		
19	1,059,602.76	2,649	3.54	$2.60	$3,685.33	$3,543.58		
20	1,033,112.69	2,583	3.45	$2.64	$3,647.09	$3,506.82		
Total	26,438,204.91	66,096	88.36		$80,355.04	$77,264.46	$228,218.00	$219,440.38

15. Appendix K. Calculations of Salt Savings to Customers

Cost of salt per lb (as of year 2005) = $0.125
Equipment efficiency discount of 2.5% begins in the 4th year after the water softener is placed in operation
Escalation rate of 1.5% applied to the cost of salt over 20 years
Discount rate of 4.0% applied to the cost of salt over 20 years

Equipment Life (Year)	Reduction of salt used for regeneration per customer (lbs/month)	Reduction of salt used for 400 customers (lbs/yr)	Estimated cost of salt per lb over 20 years ($)	Undiscounted total savings for 400 customers ($/yr)	Discounted total savings for 400 customers ($/yr)
1	50	240,000	$0.127	$30,450.00	$29,278.85
2	50	240,000	$0.129	$30,906.75	$28,575.03
3	50	240,000	$0.131	$31,370.35	$27,888.13
4	**49**	**234,000**	**$0.133**	**$31,044.88**	**$26,537.30**
5	48	228,150	$0.135	$30,722.79	$25,251.90
6	46	222,446	$0.137	$30,404.04	$24,028.76
7	45	216,885	$0.139	$30,088.60	$22,864.86
8	44	211,463	$0.141	$29,776.43	$21,757.35
9	43	206,176	$0.143	$29,467.50	$20,703.48
10	42	201,022	$0.145	$29,161.78	$19,700.65
11	41	195,996	$0.147	$28,859.22	$18,746.40
12	40	191,097	$0.149	$28,559.81	$17,838.37
13	39	186,319	$0.152	$28,263.50	$16,974.33
14	38	181,661	$0.154	$27,970.27	$16,152.13
15	37	177,120	$0.156	$27,680.08	$15,369.76
16	36	172,692	$0.159	$27,392.90	$14,625.29
17	35	168,374	$0.161	$27,108.69	$13,916.88
18	34	164,165	$0.163	$26,827.44	$13,242.78
19	33	160,061	$0.166	$26,549.11	$12,601.33
20	33	156,059	$0.168	$26,273.66	$11,990.96
Total reduction of salt used for regeneration over the life of the equipment (lbs)		**3,993,687**		**$578,877.81**	**$398,044.53**

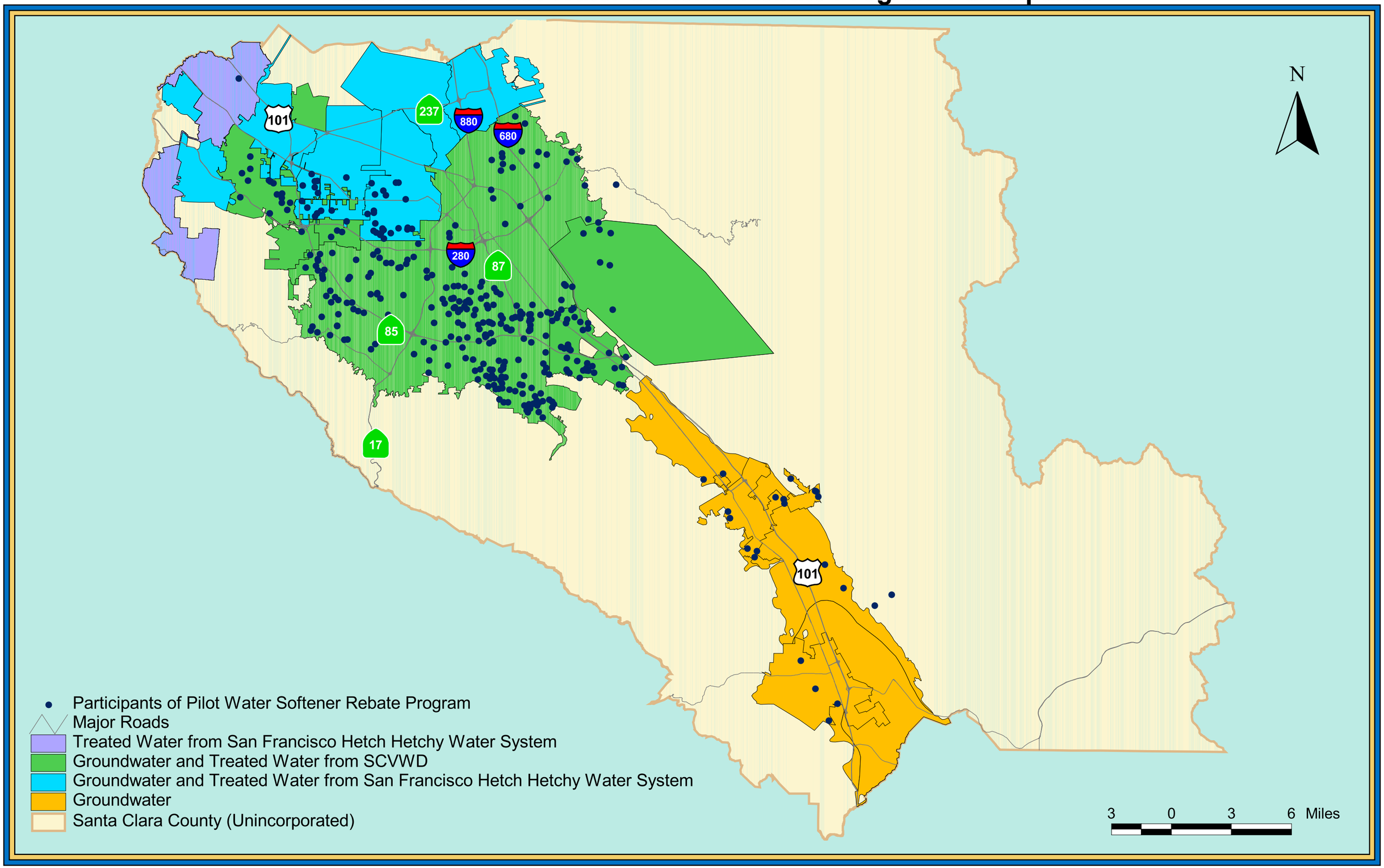
16. Appendix L. Cost-Benefit Analysis from the SCVWD's Perspective

Avoided Water Supply Cost as of 2005 ($/AF) = $430
Equipment efficiency discount of 2.5% begins in the 4th year after the water softener is placed in operation
Escalation rate of 1.5% applied to the cost of salt over 20 years
Discount rate of 4.0% applied to the cost of salt over 20 years

Year	Water Savings (gallons)	Water Savings (AF)	Undiscounted Water Savings ($)	Discounted Water Savings ($)	Undiscounted Costs ($)	Discounted Costs ($)
1	1,588,800.00	4.88	$2,096.61	$2,015.97	$75,168.00	$72,276.92
2	1,588,800.00	4.88	$2,128.06	$1,967.51		
3	1,588,800.00	4.88	$2,159.98	$1,920.21		
4	**1,549,080.00**	**4.75**	**$2,192.38**	**$1,874.05**		
5	1,510,353.00	4.64	$2,225.26	$1,829.00		
6	1,472,594.18	4.52	$2,258.64	$1,785.04		
7	1,435,779.32	4.41	$2,292.52	$1,742.13		
8	1,399,884.84	4.30	$2,326.91	$1,700.25		
9	1,364,887.72	4.19	$2,361.81	$1,659.38		
10	1,330,765.52	4.08	$2,397.24	$1,619.49		
11	1,297,496.39	3.98	$2,433.20	$1,580.56		
12	1,265,058.98	3.88	$2,469.70	$1,542.57		
13	1,233,432.50	3.79	$2,506.74	$1,505.48		
14	1,202,596.69	3.69	$2,544.34	$1,469.30		
15	1,172,531.77	3.60	$2,582.51	$1,433.98		
16	1,143,218.48	3.51	$2,621.25	$1,399.51		
17	1,114,638.02	3.42	$2,660.57	$1,365.86		
18	1,086,772.07	3.34	$2,700.47	$1,333.03		
19	1,059,602.76	3.25	$2,740.98	$1,300.99		
20	1,033,112.69	3.17	$2,782.10	$1,269.71		
Total	**26,438,204.91**	**81.14**	**$48,481.27**	**$32,314.01**	**$75,168.00**	**$72,276.92**

Appendix M. Location of Pilot Water Softener Rebate Program Participants

Location of Pilot Water Softener Rebate Program Participants



Santa Clara Valley Water District

5750 Almaden Expressway
San Jose, California 95118-3614
Tel. 408.265.2600
Fax. 408.266.0271
www.valleywater.org